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TABLES

FOR

AZIMUTHS AND GREAT-CIRCLE SAILING,

LATS. AND DECLS. 90° N. to 90° S.

THIRD EDITION, 1911.

6/-

H. S. BLACKBURNE.

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TABLES

FOR

AZIMUTHS, GREAT-CIRCLE SAILING,

AND

REDUCTION TO THE MERIDIAN,

WITH A

NEW AND IMPROVED "SUMNER" METHOD;

LATITUDES	90° N. TO 90° S.
DECLINATIONS	90° N. TO 90° S.

Azimuths through Tables A, B, and C (or separately through Table D), for all the Heavenly Bodies at any Time the Body is above the Horizon; and Great-circle Sailing-courses for all Latitudes.

Also other Useful Navigational Tables, with Numerous Examples of Double Altitudes, Equal Altitudes, Azimuths, &c.

BY

H. S. BLACKBURNE (Extra Master),

Principal Examiner of Masters and Mates in New Zealand, and Nautical Adviser to the Government.

PUBLISHED BY DIRECTION OF THE HON. THE MINISTER OF MARINE.

WELLINGTON, N.Z.
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1911.

Price 6/-]

PREFACE.

THE tables and problems here published are a reprint, for the most part of the azimuth tables which have been published in the first three years' issues of the "New Zealand Nautical Almanac."

Tables D and G are now reprinted and brought up to date from the writer's original tables published in 1883, and Tables A, C, and D have been extended from 60° to 85° of latitude. This will meet the needs of Arctic and Antarctic explorers, as well as the traders to such places as Archangel. Some years ago the writer promised Captain Liddle, who was then trading to Archangel, that he would extend his tables to latitude 72° to meet the needs of those trading in these high latitudes, outside the limits of the ordinary azimuth tables. With this extension they now constitute the most complete and comprehensive azimuth tables yet submitted to the seafaring community, giving with great simplicity sufficient accuracy to meet even the requirements of the extra-masters' examination. By the aid of Tables A, B, and C (when the hour-angle is known) the true bearing of the sun, moon, planets, and fifty-one of the brightest stars may be found in a couple of minutes at *any* hour of the day or night by the use of only about half a dozen figures.

As requests have been made from candidates for examination for permission to use these A, B, and C tables for solving some of the problems in the examination for masters and mates, and recommendations have been made for their use in the local examinations in New Zealand, these tables are now published separately, and, for the sake of giving the azimuth with greater precision for examination purposes, the factors are given in Tables A and B to three places of decimals when hour-angles are between four and eight hours, except in the very high latitudes, where so many decimals are unnecessary.

The comprehensiveness of the A, B, and C tables for azimuth purposes is simply marvellous. They cover only forty-two pages, and give not only all the azimuths of the above-mentioned heavenly bodies comprised in the four large tables of inspection (which cover several hundred pages), but also a considerable number of azimuths which are outside the limits of the larger tables. They are therefore especially valuable for use in the "Sumner" and "double altitude" problems, where the large azimuth tables omit to give the azimuth when the body is near either the upper or lower meridian. It was this omission (which is especially felt in low latitudes) which first led the writer to calculate and publish his original A and B azimuth tables. When the price of the large azimuth tables is taken into consideration (Burdwood's and Davis's for the sun, and Davis's and Goodwin's for the higher-declination stars), amounting altogether to £1 13s, the boon to navigators in the

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Calculated Azimuths supplementary to Davis's for a Few High Declination Stars, 0 Hours to 3 Hours from Meridian below the Pole;

Calculated Reductions and Azimuths for 17 of the Brightest Circumpolar Stars up to 1 h. 15 m. from the Meridian below the Pole; also

An Ex-meridian Table for Calculating the Latitude with Hour-angles, often 2 Hours and occasionally 3 Hours from the Meridian.

LATITUDES	85° N. TO 85° S.
DECLINATIONS	85° N. TO 85° S.

BY

H. S. BLACKBURNE AND CHARLES WESTLAND.

PRICE, 7s. 6d.

BOOK OF "SUMNER" CHARTS.

PRICE, 2s. 6d.

A book containing examples of positions found by the improved "Sumner" method from ex-meridians, and twenty-four plane blank "Sumner" charts on a convenient scale for facilitating the "Sumner" problem in connection with Captain Blackburne's A, B, and C azimuth tables mentioned above.

Every single chart is available for any latitude through the aid of the above-mentioned tables, by which greater accuracy of position is found, as well as a wider range for observation, than is given by the usually taught "Sumner's" method.

NOTE.—With reference to the above, Lieutenant G. W. Logan, United States Navy, editor of latest revised edition of Bowditch's "American Practical Navigator," states that "the plane chart for plotting the intersection of 'Sumner' lines is excellent, and I freely concede that your method by means of Table C^2 is an improvement on my own for those who work 'Sumner's' with one position and an azimuth.—U.S.S. 'Castine,' Santo Domingo City, S.D., 17th January, 1905."

Mr. H. B. Goodwin, R.N., M.A., author of several works on navigation, &c., formerly Examiner in Nautical Astronomy at the Royal Naval College, Greenwich, says:—

"I notice several interesting features in your present edition, notably the adaptation of 'Sumner' methods to plane charts, which should be more generally known."—Aug., 1905.

Later.—"I have also looked more carefully into your C^2 Table than I had done previously, and think that it embodies a very happy idea. . . . The attraction of the process to myself is that so small a table suffices."—Nov., 1908.

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Extracts from Paper Reviews and Letters re A, B, C Azimuth and Reduction Tables.

[*Nautical Magazine*, September, 1908.]

In the new edition of his well-known A, B, C, and D Tables, Captain Blackburne must surely have cut all existing records. . .

[*Shipping Illustrated*, New York, 5th December, 1909.]

These tables, as set forth in the present edition, are the most complete and comprehensive Azimuth and Ex-meridian Tables for practical work yet published.

[*Shipping World*, 9th December, 1908.]

The new issue of his A, B, and C Tables for Azimuth, &c., which has reached us from the New Zealand Government's Marine Department, through the High Commissioner, in London, is undoubtedly the most complete and comprehensive volume on this subject yet published. . . .

[*Mariner*, 15th December, 1908.]

Sufficient is it to say that the various navigation tables, rules, and examples, including a new and improved "Summer" method, make the volume on all counts one of the most complete and authoritative that we know in nautical literature.

[From Captain THOMAS MINCHAM, Teacher of Navigation, Auckland, New Zealand, 7th December, 1908.]

The A, B, C Azimuth Tables I have used from the start of their publication. I prefer them to all others as more simple, and much easier to learn.

[From Mr. W. H. SWENY, Chief Officer, P. and O. s.s. "Moolton," Adelaide, 23rd January, 1909.]

I have now had your new edition of Azimuth and Reduction to the Meridian Tables in use for one Australian voyage, using them almost daily for stellar observation. The results obtained have been surprising, and so satisfactory that I have discarded all other books on these problems.

[From Captain JOHN OWEN, Teacher of Navigation, Cardiff, 25th January, 1909.]

Your method of solving the Time Azimuth problem by the A, B, C Tables is concise, and easy of solution. If these tables were more generally known, I think seafarers would use them in preference to Burdwood's or any other special tables employed at present.

[From Mr. JOHN BLENCOWE, late Second Officer, B.I. s.s. "Shirala," Auckland, New Zealand, 9th February, 1909.]

In Lyttelton I obtained a copy of your new Azimuth and Ex-meridian Tables, and on showing them to my brother officers they were so taken with them that they all bought a copy for themselves. I think the tables are splendid, and for the sake of the profession will do all I can to make them more widely known.

[From Captain F. P. EVANS, s.s. "Nimrod," of the Antarctic Expedition.]

I should like to mention that we found the A, B, C Tables of Captain Blackburne of the very greatest assistance during last voyage. In high latitudes, with doubtful variation values, it was a great convenience to have a quick method of solving azimuths at hand.—Lyttelton, N.Z., 26th March, 1909.

[From Mr. S. C. WARNER, Chief Officer, P. and O. s.s. "Socotra," off Minikoi Island, 13th September, 1910.]

I should like to add my humble testimonial to the new A, B, C Book you have brought out, and to tell you how much it is appreciated here on board. I certainly think it is the very best book of navigation ever printed.

[From Captain GEORGE BURTON, Instructor of Cadets, Ocean Training-ship "Port Jackson," off Australia, 26th November, 1910.]

I have shown your book to all our senior cadets, and advised them to procure copies. The book is certainly altogether the most complete education in modern navigation yet published.

PREFACE TO THIRD EDITION.

OVER fifty pages have been added to this edition of the azimuth tables. Seventeen of these pages have been added to give an alternate method of taking out the azimuth by the use of a traverse-table and Table C[1] This was the plan originally adopted by the author in the first editions of his A and B Tables, and it is now given again for the sake of giving the azimuth to the nearest minute of arc, when the azimuth is used and precision is required in connection with the ex-meridian problem, or for any other purpose. At the request of Lieutenants Edward R. G. R. Evans, R.N., and Harry L. L. Pennell, R.N., the commander and navigating lieutenant of the British Antartic Expedition s.s. "Terra Nova," the limits of the A and B Tables have now been further extended so as to include all latitudes and declinations between the terrestial and the celestial North and South Poles. The tables are thus made available for azimuth, great-circle sailing, and reduction to the meridian for every part of the globe, and for every star in the heavens.

The two small but very comprehensive ex-meridian tables which are used in conjunction with the A and B Tables, and were published in 1908, together with other and more extensive ex-meridian tables in the edition, entitled "Tables for Azimuth, Great-circle Sailing, and Reduction to the Meridian," are reproduced in this edition, and by the above-mentioned extension of the A and B Tables to latitudes and declinations of 90° the ex-meridian tables are now available for every latitude and declination, and although the tables only comprise four pages they cover wider limits of use than almost any other published ex-meridian tables, and are equally available for below-Pole as for the above-Pole observations. The additional title of "Reduction to the Meridian" has been purposely omitted on the cover of the book for fear of confusion with the large tables in which the reduction and azimuth have been calculated, and are shown at sight for several of the brightest circumpolar stars.

The table giving the apparent times of the meridian passages of the principal fixed stars, and the table for correction of sun's and star's altitude for heights from 6 ft. to 80 ft., were calculated with great care and accuracy for the "New Zealand Nautical Almanac," where they have been published for the last three years.

A new departure has been taken in connection with the first-named table in giving the times of *inferior* as well as the *superior* transits of no less than forty-five of the circumpolar stars.

This should be a great boon to navigators as (so far as the author knows) no other navigational works give the times of star's meridian passages at the *inferior* transit, notwithstanding the special value of the below-Pole star for determining latitudes on account of its slow motion in altitude and azimuth.

A small table comprising two pages has been added after the ex-meridian table showing the error in latitude by ex-meridian due to 4 seconds of error in the time. This table is especially useful in facilitating work in connection with the problem of finding the position of ship from two ex-meridians, or one ex-meridian and a chronometer observation, and quite dispenses with any need of a chart.

In closing, the author has much pleasure in acknowledging the kind gratuitous help received from Mr. Charles Westland in connection with the ex-meridian tables. The author's original table was No. 2 Ex-meridian Table, but after Mr. Westland had seen it he improved on it and gave him the formula for No. 1 Ex-meridian Table, which is an undoubted improvement on the original table. He also very kindly helped in the calculation of the new table, and in the still tougher work of calculating a table showing the hour-angle limits within which the table might be safely used.

Ex-meridian Table No. 2 (although superseded by Table No. 1) has been retained, as it was found that with higher declinations it gave the best results, and by transposing latitude and declination when latitude is over 55° the limits of the table may also be extended, as shown in example on page 157 with high latitudes and smaller declinations.

H. S. BLACKBURNE.

Wellington, New Zealand,
September, 1911.

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EXPLANATION OF TABLES.

The A, B, and C Azimuth Tables.

TABLES A and B are used in combination—(1) for finding the error of the longitude due to an error of one minute (1′) of latitude, and (2) by the aid of Table C to find the azimuth or true bearing of celestial objects.

Enter *Table A* with the hour-angle and latitude, and *Table B* with the hour-angle and declination, naming the factors taken from these tables according to the following rule:—

For *Table A*—When hour-angle is less than 6 hours, name the factors taken from this table *contrary* to name of latitude.

When hour-angle is greater than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

For *Table B*—Always name the factors taken from Table B the *same* as the name of declination.

Add like and subtract unlike names. The sum or difference then of the factors from A and B will be the difference of longitude correction due to 1′ of error in the latitude. The correction must be named according to the name of the greater factor.

The direction of this longitude correction (or the position-line, as it may be termed) is found by keeping the name thus obtained, and reversing the name of the object's bearing E. or W. of meridian.

For the *Azimuth*—With the A and B cor. thus found and named, enter Table C with the latitude and this cor.; the corresponding azimuth is then taken out direct, and is given to the nearest decimal of a degree. It is named N. or S. according to the name of the cor., and East or West as the hour-angle is east or west of the meridian. The azimuth with these tables never exceeds 90°. This saves the trouble (which also confuses some when using the large azimuth tables) of having to subtract the azimuth taken out from 180°, and change the name of azimuth.

Traverse Table and Table C[1].

For the Azimuth when greater accuracy is required.—When using the azimuth table to assist in the reduction to the meridian it is important to take out the azimuth with greater precision than is necessary under ordinary circumstances for compass-correction or position-lines. For this purpose a traverse-table (pages 58–67) and Table C[1] (pages 68–74) are used as follows:—

Rule.—Turn the A ± B (= difference of longitude correction) into departure by the traverse table, and take out the *azimuth* corresponding to the factor from the azimuth Table C[1]. The azimuth in this table is given to the nearest minute of arc for 45° from the meridian.

EXAMPLES: TO FIND THE AZIMUTH.

(1.)	Lat.	41°·3 S.	(p. 20)	A	·274 S.	
	⊙'s Decl.	23°·5 S.	(p. 21)	B	·455 S.	
	H.A.	7h. 10m. W.	(p. 43)	C	·729 S.	gives Az. S. 61°·2 W.

(2.)	Lat.	43° 30′ S.	(p 20)	A	′452 N.	(p. 63)	1′0	=	′725
	* α Centauri	S.	(p. 21)	B	1·955 S.	(p. 60)	·503	=	·365
	H.A.	4h. 18m.		D. long.	1·503 S.		Dep.		1·090
				= Dep.	1·090	gives Az. (C¹, p. 69) S. 42° 32′.			

For further examples see pages 119–120, and on page 121 for Great-circle Sailing-courses.

Formulæ used in the Calculation of the Tables.

A = tang of latitude × cotang of hour-angle.

B = tang of declination × cosec of hour-angle.

For C "Azimuths," cot azim. = cor. × cos latitude, where cor. is the result of the sum or diff. of A and B.

For C^1 "Azimuths," cotan azim. = correction.

For C^2 "Position-lines," tan position-line = correction.

Interpolation.

When it is deemed necessary to interpolate, this can usually be done at sight, except for the hour-angles up to the first hour from the meridian, and in a high latitude up to the second hour from the meridian.

For Table A, when both time and latitude are nearly midway between that given in the table, interpolate diagonally; for example, lat. 40° 30′, hour-angle 2 h. 22 m., it will be seen at a glance that 1·20 is the correct factor. For Table B there is no appreciable difference in 4 m. of time (except in the very small hour-angles), and it is therefore only necessary to interpolate *vertically* for the fraction of the degrees of declination. For the bright stars no interpolation is necessary even for the declination, as the declination of a star does not appreciably change for many years, and the factors are here calculated for the stars' declination corresponding to the year 1910. For both Tables A and B the interpolation of the small hour-angles up to 1 hour should be effected by dividing the quantity given at 1 m. by the number of minutes that the body observed is from the meridian. The variation to 1′ of latitude at 0 h. 1 m. is given to assist in the interpolation for the odd minutes of latitude, in case surveyors or others should require a very accurate azimuth.

The following example will illustrate how the interpolation may here be effected:—

Lat. 40° 36′, H.A. 0 h. 10 m.: required the azimuth.

Lat. 40° at 0 h. 1 m. A. = 192·3′ var. to 1′ of lat. = 6·82″ or 6·82′ to 1° of lat.

Cor. to 36′ = + 4·1 (10) 196·4) 36′ = 0·6° × 6·82′ = 4·09′

Lat. 40° 36′ = 19·64 = from Table C Az. 3·8°

If greater accuracy is required, 19·64′ × cos lat. 40° 36′ gives cot az. 3° 50′.—

19·64′	log	1·2931
40° 36′	cos	9·8804
3° 50′	cot	11·1735

Example to find the Difference of Longitude due to Error in the Latitude.

In lat. by D.R. 16° 30′ N., hour-angle 2 h. 44 m. E. and ⊙'s declination 11° S., the longitude was found to be 40° 50′ E. Required the longitude, in latitude 16° 38′ N., the latitude previously worked with having been found to be 8′ in error.

A = ·34′ S.
B = ·30′ S.

Sum ·64′ S. to W. = cor. or error in the longitude due to
Lat. found to be 8′ N. of D.R. 8 1′ of error in the latitude.

Cor. to 8′ of lat. .. .. 5·12′ or 5′ 7·2″ S. to W. or N. to E.

	°	′	″	
Lat. 16° 30′ N. gives long.	40	50	0	E.
Cor. due to 8′ of lat.	0	5	7	E.
Lat. 16° 38′ N. gives long.	40	55	7	E.

Knowing the error of longitude due to an error of 1′ of latitude, we have the means ready at hand of quickly determining both the latitude and longitude when two suitable observations have been taken of celestial objects.

This may be effected either by plotting the two positions and position-lines on the chart, which is the ordinary "Sumner" problem (worked with only two instead of the usual four hour-angles), or the position may be found even more expeditiously by simple proportion.

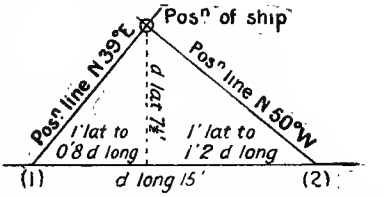
The actual trend of the position-line for plotting on the *plane* chart may be found from Table C[2], attending to the rule there given; or, by subtracting the azimuth as found from Table C from 90°, and reversing the name of the object's bearing, the *true* position-line will be found for plotting on a *Mercator* chart.

Any single observation, whether on or near the meridian, or prime vertical, or any other bearing, simply gives a position as being somewhere on a line of bearing at right angles to the bearing of object. If a second observation is taken after the body has changed its bearing, or another body is observed at the same time having a different bearing, we get another line of position, and the intersection of the two position-lines will give the latitude and longitude of the observer. Without the trouble of putting the position on the chart, the same principle may be worked out by a little proportion sum.

The three elements used in finding the time or longitude are latitude, altitude, and declination. If these three elements are correctly known, the *same* time or the *same* longitude will be found by every celestial body observed, whatever the bearing may be. If, therefore, the declination and altitude *are* correctly known, any difference of longitude found, resulting from the observation of different bodies (or the same body after an interval of time between the observations), must be due to error in the *latitude*.

The error in longitude due to 1′ error of latitude is given by the A and B Tables. It becomes, therefore, a simple matter of proportion to find the correction to apply to the latitude used in finding the longitude. Say the longitudes resulting from the observation of two different stars are 15′ apart, and with star No. 1 every 1′ north of latitude throws the longitude 0·8′ more to the east, with star No. 2 every 1′ north of latitude throws the longitude 1·2′ more to the west, then every 1′ of error in the latitude will throw the longitudes 2′ apart, and the error of latitude will be found by the proportion 2′ d. long. : 15′ d. long. :: 1′ lat. : 7½′ lat.

This would be represented on the chart by the accompanying figure.



The writer has found the ship's position by this method many hundreds of times, and finds that he gets a more accurate latitude in this way than even by the meridian altitude, experience having shown that although an altitude may often be slightly in error, yet a correct *difference* in altitude is generally measured, or the same amount of error will generally be thrown into both observations, and when this is the case (if the observations are suitably chosen) small errors in altitude practically make *no* difference in the latitude. Observations which have been taken in the quicksilver of two stars not near the meridian, or of two sun observations with a suitable interval of time between them, have generally given the latitude within o·1′ of the truth, when taken where the position of places has been accurately known.

Table C^2.—Position-lines.

Table C^2 gives the position-lines corresponding to the A and B correction at any time for plotting on a plane scale chart. By the aid of this small table any one possessing a protractor rule with the ordinary diagonal, or any other scale of inches, can plot the "Sumner" position in his sight-book with even greater accuracy than he could obtain it from the ordinary "Sumner" Mercator charts. The table does not give the *true* geographical lines of position, but lines of position which will give the same result as to latitude and longitude on a plane chart as the true lines of position would give on a Mercator chart. See instruction at foot of page under the table (p. 75).

Table D.—Altitude and Time-azimuth Table, showing the Error produced in the Time or Longitude by an Error of 1′ in the Altitude.

This table gives best results for azimuth when body is near the meridian. It will not give accurate results when body is near the prime vertical, and there is then uncertainty as to naming the azimuth N. or S. of the prime vertical.

Rule for finding the Azimuth.

With H.A. as Az. and decl. as lat., go to Table D.
Take out coefficient; call it M.
With alt. as lat. and M., take out Az. at top or side.

Example (see p. 111):—Alt. 84°, lat. 51½° N., H.A. $0^h\ 16\frac{1}{2}^m$, decl. 46° N.
(p. 81) Lat. (dec.) 46° N., Az. (H.A.) $16\frac{1}{2}^m = 4{\cdot}1°$, M. = 82·5.
(p. 83) Lat. (alt.) 84°, and M. 82·5 gives Az. 27·6°

Table D will be found very useful in working out separately a set of observations, both with artificial horizon and at sea; or for working out another person's observations, taken within a few minutes of the same time. It also shows at sight the degree of dependence of any observation. And if at any time it is found that an erroneous altitude has been worked with, the longitude will readily be corrected by this table, a greater altitude giving a smaller hour-angle, or with A.M. sights a greater altitude making the longitude more to the eastward, and a lesser altitude making the longitude more to the westward—*vice versa* with P.M. sights.

It will also be found useful when taking time azimuths by the sun or stars (when altitude is low) for readily obtaining the correct hour-angle, as in the following example: Lat. 20° N., ✱ Arcturus bearing N. 71° E. (true), altitude 5°. Table D at lat. 20° and azimuth 71° gives 4·5 m. of time to 1° change of alt. Table 26 (Raper), lat. 20° N., decl. 20° N., gives ✱'s hour-angle at rising or setting 6 h. 30 m

4·5 m. × 5° =	− 22½
✱'s H.A. at 5° =	6 7½

The results of the table can be easily found by inspection from the traverse table At the Equator, when the sun or any other heavenly body is on the prime vertical, it moves at the rate of 1° in 4 m., or 1′ in 4 s. of time; and, in any other latitude, when the sun is on the prime vertical, the ratio of its movement will be dep.: diff. long. Having, then, the rate of movement in any latitude on the prime vertical, the rate of movement on any other bearing may be found by the traverse table.

Example.—In latitude 30°, and ⊙'s bearing N. 63° E., required the rate at which it moves. In latitude 30°, against 4 in D. lat. column, is 4·62 in dist. column; with ⊙'s bearing 63°, and 4·62 in dep. column, we have 5·18 in distance column = 5·18 s. to 1′ of altitude.

The following formula was used in the calculation of the table: D = secant of latitude × cosecant of azimuth × 4.

Further examples in the use of the table are given on pages 125 and 152.

Table E.—Altitude Corrections of Sun and Stars.

This table (the upper half for the sun, and the lower half for the stars) gives the lump correction to apply to their observed altitudes, involving for the sun dip, refraction, semidiameter, and parallax, and for the stars dip and refraction.

As the correction for very small altitudes changes rapidly, a supplementary table is given on page 87 for the correction of both sun and stars, at a height of 40ft. above sea-level, for altitudes between 3° and 11°, for every few minutes of altitude, and for other heights greater or less than 40ft. a second correction is given in same table.

Heights are given from 6ft. to 80ft. so as to meet the need of navigators in every class of vessel, from the smallest to the largest. As standard authorities still slightly differ in their dip and refraction tables, a mean of the dip and refraction given in the three standard works (Raper, Inman, and Norie) has been used in the calculation of the table here given, and great care has been taken to insure accuracy.

Table F.—Acceleration Table.

This table is used for converting intervals of mean solar time into equivalent intervals of sidereal time. The seconds column which is given in most navigational tabular works has here been omitted for the sake of space, and because it is considered quite unnecessary in ordinary practical navigation. In practical navigation it becomes necessary in nearly all the problems where stars are used to convert mean solar time into sidereal time, as, for instance, in the time azimuth, longitude by chronometer, and the ex-meridian problems. In these problems the time is generally taken by a chronometer keeping mean solar time, and to compare this with the sidereal time found by the stellar observation it must be reduced to sidereal time.

Examples will be found among some of the worked-out problems which follow the tables in this book.

Table G.—Star Polaris Azimuth Table.

This table is useful especially in latitudes between 15° N. and 30° N., as, for instance, in the Red Sea. In a high latitude the altitude will be too high for compass-correction work, and it is not therefore given beyond 60° of latitude.

Examples in the use of table are given later on in this book.

The table has been calculated for stars' declination in 1910 — viz., 88° 49′ 33·57″ N.

The Mean Places of 108 of the Brightest Stars, in order of Right Ascension, for 1st January, 1912.

On pages 7–8 the *mean* places of 108 of the brightest stars are given, in the order of their right ascension, for the 1st January, 1912. In the column headed "Mag." the adopted unit of brightness is designated 1·0. The magnitudes of stars are determined to tenths of a magnitude with reference to this adopted unit. The magnitudes of the ten stars brighter than the unit are indicated by figures less than 1·0: thus, the value 0·3 for Arcturus indicates that that star is seven-tenths of a magnitude brighter than the unit; the value −1·4 for Sirius that it is 2·4 magnitudes brighter than the unit. As the right ascensions and declinations of the stars do not change uniformly throughout the year, the correction for intermediate months cannot be made accurately by multiplying the annual change by a fraction of the year; but the change is so small that for navigational purposes at sea the right ascensions and declinations here given may be used without appreciable error for azimuths and latitudes, and even for longitude the error due to using these elements would seldom exceed a mile. When accuracy is required the navigator should use the "Admiralty Nautical Almanac," where the right ascensions and declinations of these and many other stars are given very minutely for every ten days throughout the year.

Approximate Apparent Times of the Meridian Passages of the Principal Fixed Stars.

The times are given in this table for the 1st of each month, and the meridian of Greenwich. To find the time for any other day *subtract* the portion of time corresponding to the day of the month in the day-correction table. Add 1 min. for every 90° of east longitude and subtract 1 min. for every 90° of west longitude.

The time of the meridian passage of each star has been carefully calculated to the nearest second of time, and is given in the table to the nearest minute.

For the circumpolar stars which never set in higher latitudes than 50° N. or S. the times of the meridian passages of the *inferior* as well as the *superior* transit has been given.

EXAMPLE AND CAUTION IN USING THIS TABLE.

Required the meridian passage of * β Centauri on 31st October, in longitude 10° W.

	H. M.	
Mer. pass. of * β Centauri on 1st Oct. is	1 30	p.m.
Cor. for 31st day	− 1 52	
	D.	
Approx. time	31 23 38	= 11 38 a.m. on 1st Nov.
2nd cor. required	− 4	
	D.	
Approx. mer. pass. * β Centauri	31 23 34	or 11 34 a.m. on 1st. Nov.

The interval in this case is within 2 hours of 31 days instead of 30 days, therefore nearly 4 minutes more correction is required to be subtracted. The correction for longitude would be less than 10 seconds.

The table is calculated for the year 1910, but will be within 2 min. for many years, with the single exception of the * Polaris which has an annual and increasing change in R.A. of over 27 s., and will therefore be about 5 min. later in passing the meridian in 10 years' time.

Supplementary Ex-meridian Tables, &c.

Explanations given on page 143.

THE MEAN PLACES OF 108 OF THE BRIGHTEST STARS

IN ORDER OF RIGHT ASCENSION,

FOR 1st JANUARY, 1912.

Star's Name.	Mag.	Right Ascension.	Annual Change.	Declination.	Annual Change.
		H. M. S.	s.	° ′ ″	″
α Andromedæ .. (*Alpheratz*) ..	2·1	0 3 50·2	+3·08	N. 28 36 17	+20·0
β Cassiopeiæ	2·4	0 4 28·5	3·12	N. 58 39 52	+20·0
α Phœnicis	2·4	0 21 56·3	2·95	S. 42 47 2	−20·0
α Cassiopeiæ .. (*Schedar*) ..	Var.	0 35 30·3	3·38	N. 56 3 18	+19·8
β Ceti .. .. (*Deneb Kaitos*) ..	2·2	0 39 10·4	3·00	S. 18 28 10	−19·8
γ Cassiopeiæ	2·3	0 51 23·2	+3·59	N. 60 14 26	+19·5
β Andromedæ .. (*Mirach*) ..	2·4	1 4 48·0	3·34	N. 35 9 15	+19·2
δ Cassiopeiæ	2·8	1 20 2·9	3·86	N. 59 46 42	+18·8
α Ursæ Minoris .. (*Polaris*) ..	2·1	1 27 51·0	27·79	N. 88 50 11	+18·6
α Eridani .. .. (*Achernar*) ..	0·5	1 34 26·3	2·23	S. 57 41 1	−18·4
β Arietis	2·7	1 49 46·5	+3·30	N. 20 22 42	+17·8
γ^1 Andromedæ .. (*Almach*) ..	2·2	1 58 29·5	3·67	N. 41 54 29	+17·4
α Arietis .. .. (*Hamel*) ..	2·2	2 2 12·5	3·36	N. 23 2 48	+17·3
α Ceti .. .. (*Menkar*) ..	2·8	2 57 40·7	3·13	N. 3 44 42	+14·3
α Persei .. .. (*Mirfak*) ..	1·9	3 18 2·0	4·26	N. 49 32 56	+13·0
α Tauri .. .. (*Aldebaran*) ..	1·1	4 30 52·2	+3·43	N. 16 19 59	+ 7·6
α Aurigæ .. .. (*Capella*) ..	0·2	5 10 11·2	4·42	N. 45 54 34	+ 4·3
β Orionis .. .. (*Rigel*) ..	0·3	5 10 18·5	2·88	S. 8 18 9	− 4·3
γ Orionis .. .. (*Bellatrix*) ..	1·7	5 20 24·6	3·22	N. 6 16 14	+ 3·4
β Tauri .. .. (*Nath*) ..	1·8	5 20 43·7	3·79	N. 28 32 2	+ 3·4
α Leporis	2·7	5 28 50·9	+2·65	S. 17 53 5	− 2·7
ε Orionis .. .. (*Alnilam*) ..	1·7	5 31 44·9	3·04	S. 1 15 26	− 2·5
ζ Orionis .. .. (*1st* ∗) ..	2·0	5 36 19·1	3·03	S. 1 59 19	− 2·1
α Columbæ .. (*Phact*) ..	2·7	5 36 27·7	2·17	S. 34 7 14	− 2·1
κ Orionis .. .. (*Saiph*) ..	2·2	5 43 35·0	2·84	S. 9 42 1	− 1·4
α Orionis .. .. (*Betelguese*) ..	Var.	5 50 24·4	+3·25	N. 7 23 29	+ 0·8
β Aurigæ .. .. (*Menkalinan*) ..	2·1	5 53 4·5	4·41	N. 44 56 22	+ 0·6
θ Aurigæ	2·7	5 53 43·2	4·09	N. 37 12 26	+ 0·5
β Canis Majoris	2·0	6 18 49·4	2·64	S. 17 54 41	+ 1·6
α Argûs .. .. (*Canopus*) ..	−1·0	6 21 59·9	1·33	S. 52 38 50	+ 1·9
γ Geminorum .. (*Alhena*) ..	1·9	6 32 37·7	+3·46	N. 16 28 31	− 2·8
α Canis Majoris .. (*Sirius*) ..	−1·4	6 41 16·0	2·68	S. 16 35 42	+ 3·6
τ Argûs	2·8	6 47 45 1	1·49	S. 50 30 35	+ 4·1
ε Canis Majoris .. (*Adara*) ..	1·6	6 55 10·0	2·36	S. 28 51 6	+ 4·8
δ Canis Majoris	2·0	7 4 48·7	2·44	S. 26 15 10	+ 5·6
π Argûs	2·7	7 14 2·1	+2·12	S. 36 56 21	+ 6·4
η Canis Majoris	2·4	7 20 36·9	2·37	S. 29 7 51	+ 6·9
α^2 Geminorum .. (*Castor*) ..	2·0	7 28 59·2	3·85	N. 32 4 57	− 7·6
α Canis Minoris .. (*Procyon*) ..	0·5	7 34 41·7	3·19	N. 5 27 3	− 8·1
β Geminorum .. (*Pollux*) ..	1·2	7 39 56·0	3·72	N. 28 14 22	− 8·5
ζ Argûs	2·3	8 0 29·4	+2·11	S. 39 45 18	+10·1
γ Argûs	1·9	8 6 49·3	1·85	S. 47 4 37	+10·5
ε Argûs	1·7	8 20 42·5	1·24	S. 59 13 34	+11·6
δ Argûs	2·0	8 42 16·2	1·66	S. 54 23 9	+13·0
β Argûs	1·7	9 12 14·3	0·70	S. 69 21 17	+14·9
ι Argûs .. .. (*Tureis*) ..	2·2	9 14 44·0	+1·61	S. 58 54 20	+15·1
κ Argûs	2·6	9 19 23·2	1·86	S. 54 38 5	+15·3
α Hydræ .. .. (*Alphard*) ..	2·2	9 23 15·8	2·95	S. 8 16 36	+15·5
α Leonis .. .. (*Regulus*) ..	1·3	10 3 41·2	3·22	N. 12 23 52	−17·5
γ^1 Leonis .. .. (*Algeiba*) ..	2·5	10 15 7·4	3·29	N. 20 17 13	−18·0
μ Argûs	2·8	10 42 58·9	+2·57	S. 48 57 19	+18·9
β Ursæ Majoris	2·4	10 56 32·4	3·63	N. 56 51 16	−19·3
α Ursæ Majoris .. (*Dubhe*) ..	2·0	10 58 18·5	3·75	N. 62 13 35	−19·3
δ Leonis .. .. (*Zosma*) ..	2·6	11 9 25·8	3·18	N. 21 0 22	−19·6
β Leonis .. .. (*Denebola*) ..	2·2	11 44 34·3	3·10	N. 15 3 51	−20·0

THE MEAN PLACES OF 108 OF THE BRIGHTEST STARS—*continued.*

Star's Name.	Mag.	Right Ascension.	Annual Change.	Declination.	Annual Change.
		H. M. S.	s.	° ′ ″	″
γ Ursæ Majoris .. (*Phecda*) ..	2·5	11 49 12·5	+3·16	N. 54 11 3	−20·0
δ Centauri	2·8	12 3 47·5	3·10	S. 50 13 57	+20·0
γ Corvi	2·7	12 11 16·7	3·09	S. 17 3 12	+20·0
α^1 Crucis	1·0	12 21 41·6	3·32	S. 62 36 41	+20·0
γ Crucis	1·6	12 26 16·5	3·30	S. 56 37 13	+19·9
γ Centauri	2·4	12 36 39·5	+3·31	S. 48 28 36	+19·8
β Crucis	1·5	12 42 34·2	3·49	S. 59 12 28	+19·7
ε Ursæ Majoris	1·8	12 50 9·7	2·64	N. 56 26 14	−19·6
ζ^1 Ursæ Majoris	2·1	13 20 23·1	2·41	N. 55 23 5	−18·8
α Virginis .. .. (*Spica*) ..	1·2	13 20 33·3	3·16	S. 10 42 8	+18·8
ε Centauri	2·6	13 34 18·2	+3·78	S. 53 1 10	+18·4
η Ursæ Majoris .. (*Benetnasch*) ..	1·9	13 44 4·5	2·38	N. 49 45 8	−18·0
ζ Centauri	2·8	13 50 2·6	3·73	S. 46 51 20	+17·8
β Centauri	0·8	13 57 36·2	4·21	S. 59 56 56	+17·5
θ Centauri	2·1	14 1 29·9	3·56	S. 35 56 15	+17·3
α Boötis .. .. (*Arcturus*) ..	0·3	14 11 38·8	+2·81	N. 19 38 25	−16·8
η Centauri	2·7	14 29 54·8	3·80	S. 41 46 18	+15·9
α^2 Centauri	1·0	14 33 37·5	4·54	S. 60 28 15	+15·7
α Lupi	2·5	14 36 4·2	3·98	S. 47 0 40	+15·6
ϵ^2 Boötis	2·6	14 41 8·6	2·62	N. 27 26 41	−15·3
β Ursæ Minoris .. (*Kochab*) ..	2·2	14 50 57·1	−0·20	N. 74 30 54	−14·7
β Lupi	2·7	14 52 45·6	+3·92	S. 42 46 49	+14·6
α Coronæ .. .. (*Alphacca*) ..	2·3	15 30 57·7	2·53	N. 27 0 37	−12·1
α Serpentis .. .. (*Unukalhai*) ..	2·8	15 39 55·9	2·94	N. 6 42 7	−11·5
δ Scorpii	2·5	15 55 7·6	3·54	S. 22 22 19	+10·4
β^1 Scorpii .. .. (*Akrab*) ..	2·7	16 0 19·0	+3·48	S. 19 33 55	+10·0
α Scorpii .. .. (*Antares*) ..	1·3	16 24 0·6	3·67	S. 26 14 15	+ 8·2
ζ Ophiuchi	2·7	16 32 18·7	3·30	S. 10 23 22	+ 7·5
α Trianguli Australis	1·9	16 39 20·1	6·32	S. 68 52 3	+ 6·9
ε Scorpii	2·3	16 44 27·6	3·93	S. 34 8 4	+ 6·5
η Ophiuchi	2·6	17 5 19·8	+3·44	S. 15 37 0	+ 4·7
β Aræ	2·7	17 17 58·9	4·98	S. 55 26 51	+ 3·7
λ Scorpii	1·8	17 27 37·9	4·07	S. 37 2 25	+ 2·8
α Ophiuchi .. .. (*Ras Alhague*) ..	2·1	17 30 50·9	2·78	N. 12 37 24	− 2·5
θ Scorpii	2·0	17 30 59·6	4·31	S. 42 56 34	+ 2·5
κ Scorpii	2·6	17 36 24·0	+4·15	S. 38 59 7	+ 2·0
γ Draconis .. .. (*Rastaban*) ..	2·4	17 54 33·8	1·39	N. 51 29 56	− 0·5
ε Sagittarii .. .. (*Kaus Australis*)	1·9	18 18 19·8	3·99	S. 34 25 37	− 1·6
α Lyræ .. .. (*Vega*) ..	0·1	18 33 57·5	2·01	N. 38 42 4	+ 3·0
σ Sagittarii	2·1	18 49 48·5	3·72	S. 26 24 25	− 4·3
ζ Sagittarii	2·7	18 57 0·8	+3·82	S. 30 0 25	− 4·9
σ Octantis .. .. (*South Pole Star*)	5·5	19 19 42·2	96·87	S. 89 14 4	− 6·9
α Aquilæ .. .. (*Altair*) ..	0·9	19 46 29·4	2·89	N. 8 38 7	+ 9·0
α Pavonis	2·0	20 18 41·5	4·77	S. 57 1 4	−11·4
γ Cygni	2·3	20 19 4·2	2·15	N. 39 58 28	+11·4
α Cygni .. .. (*Deneb*) ..	1·3	20 38 25·9	+2·04	N. 44 57 55	+12·8
ε Cygni	2·6	20 42 39·0	2·40	N. 33 38 25	+13·1
α Cephei .. .. (*Alderamin*) ..	2·6	21 16 28·8	1·41	N. 62 12 45	+15·2
ε Pegasi	2·5	21 39 51·8	2·94	N. 9 28 16	+16·4
α Gruis	1·9	22 2 41·5	3·78	S. 47 23 16	−17·5
β Gruis	2·1	22 37 25·1	+3·58	S. 47 20 43	−18·8
α Piscis Australis .. (*Fomalhaut*) ..	1·3	22 52 47·4	3·30	S. 30 5 20	−19·2
α Pegasi .. .. (*Markab*) ..	2·6	23 0 22·6	2·98	N. 14 43 54	+19·4

NOTE.—In this table + means add, and − means subtract.

In the column headed "Mag." the adopted unit of brightness is designated 1·0. The magnitudes of stars are determined to tenths of a magnitude with reference to this adopted unit: thus the value − 1·4 for Sirius indicates that that star is 2·4 magnitudes brighter than the unit.

Approximate Apparent Times of the Meridian Passages of the Principal Fixed Stars at Greenwich on the First Day of each Month, 1910.

	Name.	Mag.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
	α Andromedæ ..	2·1	5 18	3 6	1 17	23 20	21 29	19 27	17 23	15 18	13 23	11 34	9 39	7 36
	β Cassiopeiæ ..	2·4	5 19	3 7	1 18	23 21	21 30	19 27	17 23	15 19	13 23	11 35	9 40	7 36
†S	α¹ Crucis ..	1·0	5 36	3 24	1 35	23 38	21 47	19 44	17 40	15 36	13 40	11 52	9 57	7 53
	α Phœnicis ..	2·4	5 36	3 24	1 35	23 38	21 47	19 45	17 41	15 36	13 41	11 53	9 57	7 54
†S	γ Crucis ..	1·6	5 41	3 29	1 40	23 43	21 51	19 49	17 45	15 41	13 45	11 57	10 1	7 58
	β Ceti ..	2·2	5 54	3 41	1 52	23 55	22 4	20 2	17 58	15 53	13 58	12 10	10 14	8 11
†S	β Crucis ..	1·5	5 57	3 45	1 56	0 2	22 8	20 5	18 1	15 57	14 1	12 13	10 18	8 14
†N	ε Ursæ Majoris	1·8	6 4	3 52	2 3	0 10	22 15	20 13	18 9	16 4	14 9	12 21	10 25	8 22
	γ Cassiopeiæ ..	2·3	6 6	3 54	2 5	0 11	22 16	20 14	18 10	16 6	14 10	12 22	10 26	8 23
	β Andromedæ ..	2·4	6 19	4 7	2 18	0 25	22 30	20 27	18 23	16 19	14 23	12 36	10 40	8 36
	δ Cassiopeiæ ..	2·8	6 34	4 22	2 33	0 40	22 45	20 43	18 39	16 34	14 39	12 51	10 55	8 52
†N	ζ¹ Ursæ Majoris	2·1	6 35	4 23	2 34	0 40	22 46	20 43	18 39	16 35	14 39	12 51	10 55	8 52
	Polaris ..	2·1	6 41	4 29	2 39	0 46	22 51	20 49	18 45	16 41	14 46	12 59	11 3	8 59
	Achernar ..	0·5	6 49	4 37	2 48	0 54	22 59	20 57	18 53	16 49	14 53	13 5	11 9	9 6
†N	η Ursæ Majoris	1·9	6 58	4 46	2 56	1 4	23 9	21 7	19 3	16 58	15 3	13 15	11 19	9 16
	β Arietis ..	2·7	7 4	4 52	3 3	1 9	23 15	21 12	19 8	17 4	15 8	13 20	11 25	9 21
†S	β Centauri ..	0·8	7 12	5 0	3 11	1 17	23 23	21 20	19 16	17 12	15 16	13 28	11 32	9 29
	γ¹ Andromedæ ..	2·2	7 13	5 1	3 12	1 18	23 23	21 21	19 17	17 13	15 17	13 29	11 33	9 30
†S	θ Centauri ..	2·1	7 16	5 4	3 15	1 21	23 26	21 24	19 20	17 16	15 20	13 32	11 36	9 33
	α Arietis ..	2·2	7 16	5 4	3 15	1 22	23 27	21 25	19 21	17 17	15 21	13 33	11 37	9 34
†S	α² Centauri ..	1·0	7 48	5 35	3 47	1 53	0 2	21 56	19 52	17 48	15 52	14 4	12 9	10 5
†N	β Ursæ Minoris	2·2	8 5	5 53	4 4	2 11	0 20	22 13	20 9	18 5	16 9	14 21	12 26	10 22
	α Ceti ..	2·8	8 12	6 0	4 11	2 17	0 26	22 20	20 16	18 12	16 16	14 28	12 32	10 29
	α Persei ..	1·9	8 32	6 20	4 31	2 37	0 47	22 40	20 36	18 32	16 36	14 48	12 53	10 49
	Aldebaran ..	1·1	9 44	7 32	5 44	3 50	1 59	23 53	21 49	19 44	17 49	16 1	14 5	12 2
†S	α Tri. Australis	1·9	9 53	7 41	5 52	3 59	2 8	0 5	21 57	19 53	17 57	16 9	14 14	12 10
	Capella ..	0·2	10 24	8 12	6 23	4 29	2 38	0 36	22 28	20 24	18 28	16 40	14 44	12 41
	Rigel ..	0·3	10 24	8 12	6 23	4 30	2 39	0 36	22 28	20 24	18 28	16 40	14 45	12 41
	γ Orionis ..	1·7	10 34	8 22	6 33	4 40	2 49	0 46	22 38	20 34	18 38	16 50	14 55	12 51
	β Tauri ..	1·8	10 34	8 22	6 33	4 40	2 49	0 47	22 39	20 34	18 39	16 51	14 55	12 52
	α Leporis ..	2·7	10 42	8 30	6 41	4 48	2 57	0 55	22 47	20 42	18 47	16 59	15 3	13 0
	ε Orionis ..	1·7	10 45	8 33	6 44	4 51	3 0	0 58	22 50	20 46	18 50	17 2	15 6	13 3
	ζ Orionis ..	2·0	10 50	8 38	6 49	4 55	3 4	1 2	22 54	20 51	18 54	17 6	15 11	13 7
	κ Orionis ..	2·2	10 57	8 45	6 56	5 3	3 12	1 9	23 1	20 57	19 1	17 14	15 18	13 14
	Betelguese ..	*Var.*	11 4	8 52	7 3	5 9	3 19	1 16	23 8	21 4	19 8	17 20	15 25	13 21
	β Aurigæ ..	2·1	11 6	8 54	7 6	5 12	3 21	1 19	23 11	21 6	19 11	17 23	15 27	13 24
	θ Aurigæ ..	2·7	11 7	8 55	7 6	5 13	3 22	1 20	23 11	21 7	19 11	17 24	15 28	13 25
	β Canis Majoris	2·0	11 32	9 20	7 31	5 38	3 47	1 45	23 37	21 32	19 37	17 49	15 53	13 50
	Canopus ..	−1·0	11 35	9 23	7 34	5 41	3 50	1 48	23 40	21 35	19 40	17 52	15 56	13 53
	γ Geminorum ..	1·9	11 46	9 34	7 45	5 52	4 1	1 58	23 50	21 46	19 50	18 3	16 7	14 3
†N	*Vega* ..	0·1	11 47	9 35	7 46	5 53	4 2	2 0	23 52	21 47	19 52	18 4	16 8	14 5
	Sirius ..	−1·4	11 55	9 43	7 54	6 0	4 9	2 7	0 3	21 55	19 59	18 11	16 15	14 12
	τ Argûs ..	2·8	12 1	9 49	8 0	6 7	4 16	2 13	0 10	22 1	20 5	18 18	16 22	14 18
	ε Canis Majoris	1·6	12 8	9 56	8 8	6 14	4 23	2 21	0 17	22 8	20 13	18 25	16 29	14 26
	δ Canis Majoris	2·0	12 18	10 6	8 17	6 24	4 33	2 30	0 27	22 18	20 22	18 35	16 39	14 35
	π Argûs ..	2·7	12 27	10 15	8 26	6 33	4 42	2 40	0 36	22 27	20 32	18 44	16 48	14 45
	η Canis Majoris	2·4	12 34	10 22	8 33	6 40	4 49	2 46	0 42	22 34	20 38	18 50	16 55	14 51
	Castor ..	2·0	12 42	10 30	8 41	6 48	4 57	2 55	0 51	22 42	20 46	18 59	17 3	15 0
	Procyon ..	0·5	12 48	10 36	8 47	6 54	5 3	3 0	0 56	22 48	20 52	19 4	17 9	15 5
	Pollux ..	1·2	12 53	10 41	8 52	6 59	5 8	3 5	1 2	22 53	20 57	19 10	17 14	15 10
	ζ Argûs ..	2·3	13 14	11 2	9 13	7 19	5 28	3 26	1 22	23 14	21 18	19 30	17 34	15 31
	γ Argûs ..	1·9	13 20	11 8	9 19	7 26	5 35	3 32	1 28	23 20	21 24	19 37	17 41	15 37
†S	α Pavonis ..	2·0	13 32	11 20	9 31	7 38	5 46	3 44	1 40	23 32	21 36	19 48	17 52	15 49
	ε Argûs ..	1·7	13 34	11 23	9 33	7 40	5 49	3 46	1 42	23 34	21 38	19 50	17 55	15 51
†N	α Cygni ..	1·3	13 51	11 40	9 50	7 57	6 6	4 4	2 0	23 51	21 56	20 8	18 12	16 9
	δ Argûs ..	2·0	13 55	11 43	9 54	8 1	6 10	4 8	2 4	23 55	22 0	20 12	18 16	16 13
	β Argûs ..	1·7	14 25	12 13	10 24	8 31	6 40	4 38	2 34	0 29	22 30	20 42	18 46	16 42
	ι Argûs ..	2·2	14 28	12 16	10 27	8 33	6 42	4 40	2 36	0 32	22 32	20 44	18 49	16 45
	κ Argûs ..	2·6	14 32	12 20	10 31	8 38	6 47	4 45	2 41	0 36	22 37	20 49	18 53	16 50
	α Hydræ ..	2·2	14 36	12 24	10 35	8 42	6 51	4 49	2 45	0 40	22 40	20 53	18 57	16 53

†N. or †S.—These times relate to the Meridian Passages of Circumpolar Stars at the *Inferior* Transit, N. or S. denoting the Declination of the Star.

Approximate Apparent Times of the Meridian Passages of the Principal Fixed Stars at Greenwich on the First Day of each Month, 1910—*continued.*

	Name.	Mag.	Jan.		Feb.		Mar.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.	
			H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
†S	α Gruis ..	1·9	15	15	13	3	11	14	9	21	7	30	5	28	3	24	1	19	23	20	21	32	19	36	17	33
	Regulus ..	1·3	15	16	13	4	11	16	9	22	7	31	5	29	3	25	1	20	23	21	21	33	19	37	17	34
†S	γ^1 Leonis ..	2·5	15	28	13	16	11	27	9	34	7	43	5	40	3	36	1	32	23	32	21	44	19	49	17	45
†S	β Gruis ..	2·1	15	50	13	38	11	49	9	56	8	5	6	2	3	59	1	54	23	55	22	7	20	11	18	7
	μ Argûs ..	2·8	15	55	13	44	11	55	10	1	8	10	6	8	4	4	1	59	0	4	22	12	10	16	18	13
	β Ursæ Majoris	2·4	16	9	13	57	12	8	10	15	8	24	6	22	4	18	2	13	0	17	22	26	20	30	18	26
	Dubhe ..	2·0	16	11	13	59	12	10	10	17	8	26	6	23	4	19	2	15	0	19	22	28	20	32	18	28
	δ Leonis ..	2·6	16	22	14	10	12	21	10	28	8	37	6	34	4	30	2	26	0	30	22	39	20	43	18	39
	β Leonis ..	2·2	16	57	14	45	12	56	11	3	9	12	7	9	5	6	3	1	1	5	23	14	21	18	19	14
	γ Ursæ Majoris	2·5	17	1	14	50	13	1	11	7	9	16	7	14	5	10	3	6	1	10	23	18	21	22	19	19
	δ Centauri ..	2·8	17	16	15	4	13	15	11	22	9	31	7	29	5	25	3	20	1	24	23	33	21	37	19	33
	γ Corvi ..	2·7	17	23	15	12	13	23	11	29	9	38	7	36	5	32	3	28	1	32	23	40	21	44	19	41
	α^1 Crucis ..	1·0	17	34	15	22	13	33	11	40	9	49	7	46	5	43	3	38	1	42	23	51	21	55	19	51
	γ Crucis ..	1·6	17	38	15	27	13	38	11	44	9	53	7	51	5	47	3	43	1	47	23	55	21	59	19	56
	γ Centauri ..	2·4	17	49	15	37	13	48	11	55	10	4	8	1	5	57	3	53	1	57	0	9	22	10	20	6
	β Crucis ..	1·5	17	55	15	43	13	54	12	1	10	10	8	7	6	3	3	59	2	3	0	15	22	16	20	12
	ε Ursæ Majoris	1·8	18	2	15	50	14	2	12	8	10	17	8	15	6	11	4	6	2	11	0	23	22	23	20	19
†N	γ Cassiopeiæ ..	2·3	18	3	15	52	14	3	12	9	10	18	8	16	6	12	4	8	2	12	0	24	22	24	20	21
	ζ^1 Ursæ Majoris	2·1	18	32	16	21	14	32	12	38	10	47	8	45	6	41	4	37	2	41	0	53	22	53	20	50
	Spica ..	1·2	18	33	16	21	14	32	12	39	10	48	8	45	6	41	4	37	2	41	0	53	22	53	20	50
†N	*Polaris* ..	2·1	18	39	16	27	14	37	12	44	10	53	8	51	6	47	4	43	2	48	1	0	23	1	20	57
†S	*Achernar* ..	0·5	18	46	16	35	14	46	12	52	11	1	8	59	6	55	4	51	2	55	1	7	23	7	21	4
	ε Centauri ..	2·6	18	46	16	34	14	46	12	52	11	1	8	59	6	55	4	50	2	55	1	7	23	7	21	4
	η Ursæ Majoris	1·9	18	56	16	44	14	55	13	2	11	11	9	9	7	5	5	0	3	4	1	17	23	17	21	13
	ζ Centauri ..	2·8	19	2	16	50	15	1	13	8	11	17	9	15	7	11	5	6	2	10	1	22	23	23	21	19
	β Centauri ..	0·8	19	9	16	58	15	9	13	15	11	24	9	22	7	18	5	14	3	18	1	30	23	30	21	27
	θ Centauri ..	2·1	19	13	17	2	15	13	13	19	11	28	9	26	7	22	5	17	3	22	1	34	23	34	21	31
	Arcturus ..	0·3	19	23	17	12	15	23	13	30	11	39	9	36	7	32	5	28	3	32	1	44	23	44	21	41
	η Centauri ..	2·7	19	42	17	30	15	41	13	48	11	57	9	54	7	50	5	46	3	50	2	2	0	7	21	59
	α^2 Centauri ..	1·0	19	45	17	34	15	45	13	51	12	0	9	58	7	54	5	50	3	54	2	6	0	10	22	3
	α Lupi ..	2·5	19	48	17	36	15	47	13	54	12	3	10	0	7	56	5	52	3	56	2	8	0	13	22	5
	ϵ^2 Boötis ..	2·6	19	53	17	41	15	52	13	59	12	8	10	6	8	2	5	57	4	1	2	13	0	18	22	10
	β Ursæ Minoris	2·2	20	3	17	51	16	2	14	9	12	18	10	15	8	12	6	7	4	11	2	23	0	28	22	20
	β Lupi ..	2·7	20	4	17	53	16	4	14	10	12	19	10	17	8	13	6	9	4	13	2	25	0	29	22	22
†N	α Persei ..	1·9	20	30	18	18	16	29	14	36	12	45	10	42	8	38	6	34	4	38	2	50	0	55	22	47
	Alphacca ..	2·3	20	43	18	31	16	42	14	49	12	58	10	55	8	51	6	47	4	51	3	3	1	7	23	0
	α Serpentis ..	2·8	20	51	18	40	16	51	14	58	13	7	11	4	9	0	6	56	5	0	3	12	1	16	23	9
	δ Scorpii ..	2·5	21	7	18	55	17	6	15	13	13	22	11	19	9	15	7	11	5	15	3	27	1	32	23	24
	β^1 Scorpii ..	2·7	21	12	19	0	17	11	15	18	13	27	11	24	9	21	7	16	5	20	3	32	1	37	23	29
	Antares ..	1·3	21	35	19	24	17	35	15	42	13	50	11	48	9	44	7	40	5	44	3	56	2	0	23	53
	ζ Ophiuchi ..	2·7	21	44	19	32	17	43	15	50	13	59	11	56	9	52	7	48	5	52	4	4	2	9	0	5
	α Tri. Australis	1·9	21	51	19	39	17	50	15	57	14	6	12	3	9	59	7	55	5	59	4	11	2	16	0	12
	ε Scorpii ..	2·3	21	56	19	44	17	55	16	2	14	11	12	8	10	5	8	0	6	4	4	16	2	21	0	18
	η Ophiuchi ..	2·6	22	17	20	5	18	16	16	23	14	32	12	29	10	25	8	21	6	25	4	37	2	42	0	38
†N	*Capella* ..	0·2	22	21	20	10	18	21	16	28	14	36	12	34	10	30	8	26	6	30	4	42	2	46	0	43
	β Araæ ..	2·7	22	29	20	17	18	29	16	35	14	44	12	42	10	38	8	33	6	38	4	50	2	54	0	51
	λ Scorpii ..	1·8	22	39	20	27	18	38	16	45	14	54	12	52	10	48	8	43	6	47	5	0	3	4	1	1
	α Ophiuchi ..	2·1	22	42	20	30	18	42	16	48	14	57	12	55	10	51	8	46	6	51	5	3	3	7	1	4
	θ Scorpii ..	2·0	22	42	20	30	18	42	16	48	14	57	12	55	10	51	8	46	6	51	5	3	3	7	1	4
	κ Scorpii ..	2·6	22	48	20	36	18	47	16	54	15	3	13	0	10	56	8	52	6	56	5	8	3	13	1	9
†N	β Aurigæ ..	2·1	23	4	20	52	19	4	17	10	15	19	13	17	11	13	9	8	7	13	5	25	3	29	1	26
	γ Draconis ..	2·4	23	6	20	54	19	5	17	12	15	21	13	18	11	15	9	10	7	14	5	26	3	31	1	28
	ε Sagittarii ..	1·9	23	29	21	18	19	29	17	36	15	44	13	42	11	38	9	34	7	38	5	50	3	54	1	51
†S	*Canopus* ..	−1·0	23	33	21	21	19	33	17	39	15	48	13	46	11	42	9	37	7	42	5	54	3	58	1	54
	Vega ..	0·1	23	45	21	33	19	44	17	51	16	0	13	58	11	54	9	49	7	53	6	6	4	10	2	7
†S	τ Argûs ..	2·8	0	3	21	47	19	58	18	5	16	14	14	11	12	7	10	3	8	7	6	20	4	24	2	21
	σ Sagittarii ..	2·1	0	5	21	49	20	0	18	7	16	16	14	13	12	10	10	5	8	9	6	22	4	26	2	23
	ζ Sagittarii ..	2·7	0	12	21	56	20	7	18	14	16	23	14	21	12	17	10	12	8	16	6	29	4	33	2	30
	Altair ..	0·9	1	2	22	46	20	57	19	3	17	12	15	10	13	6	11	2	9	6	7	18	5	22	3	19
†S	γ Argûs ..	1·9	1	22	23	6	21	17	19	24	17	33	15	30	13	26	11	22	9	26	7	38	5	43	3	39

†N. or †S.—These times relate to the Meridian Passages of Circumpolar Stars at the *Inferior* Transit, N. or S. denoting the Declination of the Star.

Approximate Apparent Times of the Meridian Passages of the Principal Fixed Stars at Greenwich on the First Day of each Month, 1910—*continued.*

	Name.	Mag.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
			H. M.	H. M.	H. M.	H. M.	H. M	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
	α Pavonis ..	2·0	1 33	23 18	21 29	19 36	17 44	15 42	13 38	11 34	9 38	7 50	5 54	3 51
	γ Cygni ..	2·3	1 34	23 18	21 29	19 36	17 45	15 42	13 39	11 34	9 38	7 51	5 55	3 52
†S	ε Argûs ..	1·7	1 36	23 20	21 31	19 38	17 47	15 44	13 40	11 36	9 40	7 52	5 56	3 53
	α Cygni ..	1·3	1 54	23 37	21 49	19 55	18 4	16 2	13 58	11 53	9 58	8 10	6 14	4 12
†S	δ Argûs ..	2·0	1 57	23 41	21 53	19 59	18 8	16 6	14 2	11 57	10 1	8 14	6 18	4 15
	ε Cygni ..	2·6	1 58	23 42	21 53	20 0	18 8	16 6	14 2	11 58	10 2	8 14	6 18	4 15
†S	β Argûs ..	1·7	2 27	0 15	22 22	20 29	18 38	16 36	14 32	12 27	10 31	8 44	6 48	4 45
†S	ι Argûs ..	2·2	2 30	0 18	22 25	20 32	18 40	16 38	14 34	12 30	10 34	8 46	6 50	4 47
	α Cephei ..	2·6	2 31	0 19	22 27	20 33	18 42	16 40	14 36	12 31	10 36	8 48	6 52	4 49
†S	κ Argûs ..	2·6	2 34	0 22	22 30	20 36	18 45	16 43	14 39	12 34	10 38	8 51	6 55	4 52
	ε Pegasi ..	2·5	2 55	0 43	22 50	20 57	19 6	17 3	14 59	12 55	10 59	9 11	7 15	5 12
	α Gruis ..	1·9	3 17	1 5	23 13	21 19	19 28	17 26	15 22	13 17	11 22	9 34	7 38	5 35
	β Gruis ..	2·1	3 52	1 40	23 47	21 54	20 3	18 0	15 56	13 52	11 56	10 9	8 12	6 10
	Fomalhaut ..	1·3	4 7	1 55	0 6	22 9	20 18	18 16	16 12	14 7	12 12	10 24	8 28	6 25
†N	β Ursæ Majoris	2·4	4 11	1 59	0 10	22 13	20 22	18 19	16 16	14 11	12 15	10 28	8 32	6 29
†N	*Dubhe* ..	2·0	4 13	2 1	0 12	22 15	20 24	18 21	16 17	14 13	12 17	10 29	8 34	6 30
	α Pegasi ..	2·6	4 15	2 3	0 14	22 17	20 26	18 23	16 19	14 15	12 19	10 31	8 36	6 32
†N	γ Ursæ Majoris	2·5	5 4	2 52	1 3	23 6	21 15	19 12	17 8	15 4	13 8	11 20	9 24	7 21
†S	δ Centauri ..	2·8	5 18	3 6	1 17	23 20	21 29	19 27	17 23	15 18	13 22	11 35	9 39	7 36
†S	γ Centauri ..	2·4	5 51	3 39	1 50	23 53	22 2	19 59	17 55	15 51	13 55	12 7	10 12	8 8
†S	ε Centauri ..	2·6	6 48	4 36	2 47	0 54	22 59	20 57	18 53	16 48	14 53	13 5	11 9	9 6
†S	α Lupi ..	2·5	7 50	5 38	3 49	1 56	0 5	21 58	19 54	17 50	15 54	14 7	12 11	10 7
†S	β Aræ ..	2·7	10 31	8 19	6 30	4 37	2 46	0 44	22 36	20 31	18 36	16 48	14 52	12 49
†N	γ Draconis ..	2·4	11 8	8 56	7 7	5 14	3 23	1 20	23 12	21 8	19 12	17 25	15 29	13 25
†N	α Cephei ..	2·6	14 29	12 17	10 28	8 35	6 44	4 42	2 38	0 33	22 34	20 46	18 50	16 47
†N	β Cassiopeiæ ..	2·4	17 17	15 5	13 16	11 23	9 32	7 29	5 25	3 21	1 25	23 34	21 38	19 34
†S	α Phœnicis ..	2·4	17 34	15 22	13 33	11 40	9 49	7 47	5 43	3 38	1 42	23 51	21 55	19 52
†N	β Andromedæ ..	2·4	18 17	16 5	14 16	12 23	10 32	8 29	6 25	4 21	2 25	0 37	22 38	20 34
†N	δ Cassiopeiæ ..	2·8	18 32	16 20	14 31	12 38	10 47	8 45	6 41	4 36	2 40	0 53	22 53	20 49
†N	γ^1 Andromedæ ..	2·2	19 10	16 58	15 10	13 16	11 25	9 23	7 19	5 14	3 19	1 31	23 31	21 28

† N. or † S.—These times relate to the Meridian Passages of Circumpolar Stars at the *Inferior* Transit, N. or S. denoting the Declination of the Star.

Correction of the Times in the preceding Table for the Day of the Month (to be *subtracted*).

Days.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	H. M.	H. M.	H. M.	H. M.	H. M	H. M.	H. M.	H. M	H. M.	H. M.	H. M.	H. M.
1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
2	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4
3	0 9	0 8	0 7	0 7	0 8	0 8	0 8	0 8	0 7	0 7	0 8	0 9
4	0 13	0 12	0 11	0 11	0 11	0 12	0 12	0 12	0 11	0 11	0 12	0 13
5	0 18	0 16	0 15	0 15	0 15	0 16	0 16	0 15	0 14	0 15	0 16	0 17
6	0 22	0 20	0 19	0 18	0 19	0 21	0 21	0 19	0 18	0 18	0 20	0 22
7	0 26	0 24	0 22	0 22	0 23	0 25	0 25	0 23	0 22	0 22	0 24	0 26
8	0 30	0 28	0 26	0 26	0 27	0 29	0 29	0 27	0 25	0 25	0 28	0 30
9	0 35	0 32	0 30	0 29	0 30	0 33	0 33	0 31	0 29	0 29	0 32	0 35
10	0 39	0 36	0 33	0 33	0 35	0 37	0 37	0 35	0 32	0 33	0 36	0 39
11	0 43	0 40	0 37	0 36	0 39	0 41	0 41	0 38	0 36	0 37	0 40	0 44
12	0 48	0 44	0 41	0 40	0 42	0 45	0 45	0 42	0 40	0 40	0 44	0 48
13	0 52	0 48	0 44	0 44	0 46	0 49	0 49	0 46	0 43	0 44	0 48	0 52
14	0 56	0 52	0 48	0 48	0 50	0 54	0 53	0 50	0 47	0 48	0 52	0 57
15	1 1	0 56	0 52	0 51	0 54	0 58	0 57	0 53	0 50	0 51	0 56	1 1
16	1 5	1 0	0 55	0 55	0 58	1 2	1 1	0 57	0 54	0 55	1 0	1 6
17	1 9	1 3	0 59	0 59	1 2	1 6	1 5	1 1	0 58	0 59	1 4	1 10
18	1 13	1 7	1 2	1 2	1 6	1 10	1 9	1 5	1 1	1 3	1 9	1 15
19	1 18	1 11	1 6	1 6	1 10	1 14	1 13	1 8	1 5	1 6	1 13	1 19
20	1 22	1 15	1 10	1 10	1 14	1 19	1 17	1 12	1 8	1 10	1 17	1 24
21	1 26	1 19	1 14	1 13	1 18	1 23	1 21	1 16	1 12	1 14	1 21	1 28
22	1 31	1 23	1 17	1 17	1 22	1 27	1 25	1 19	1 16	1 18	1 25	1 32
23	1 35	1 26	1 21	1 21	1 26	1 31	1 29	1 23	1 19	1 21	1 30	1 37
24	1 39	1 30	1 24	1 25	1 30	1 35	1 33	1 27	1 23	1 25	1 34	1 41
25	1 43	1 34	1 28	1 28	1 34	1 39	1 37	1 31	1 26	1 29	1 38	1 46
26	1 47	1 38	1 32	1 32	1 38	1 44	1 41	1 34	1 30	1 33	1 42	1 50
27	1 51	1 42	1 35	1 36	1 42	1 48	1 45	1 38	1 34	1 37	1 47	1 55
28	1 56	1 45	1 39	1 40	1 46	1 52	1 49	1 42	1 37	1 41	1 51	1 59
29	2 0	..	1 43	1 44	1 50	1 56	1 53	1 45	1 41	1 44	1 55	2 3
30	2 4	..	1 46	1 47	1 55	2 0	1 57	1 49	1 44	1 48	1 59	2 8
31	2 8	..	1 50	..	1 59	..	2 1	1 52	..	1 52	..	2 12

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	0 HOURS.																1 Hr.
	m. 01	Var. to 1′ of Lat.	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′ ·0	″ 4·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00	′ ·00
0	4·0	4·00	1·00	·50	·33	·25	·20	·17	·14	·12	·11	·10	·09	·08	·08	·07	·07
1	8·0	4·00	2·00	1·00	·67	·50	·40	·33	·28	·25	·22	·20	·18	·16	·15	·14	·13
2	12·0	4·01	3·00	1·50	1·00	·75	·60	·50	·43	·37	·33	·30	·27	·25	·23	·21	·20
3	16·0	4·02	4·01	2·00	1·33	1·00	·80	·66	·57	·50	·44	·40	·36	·33	·30	·28	·26
4	20·1	4·03	5·01	2·51	1·67	1·25	1·00	·83	·71	·62	·55	·50	·45	·41	·38	·35	·33
5	24·1	4·05	6·02	3·01	2·01	1·50	1·20	1·00	·86	·75	·66	·60	·54	·49	·46	·42	·39
6	28·1	4·06	7·03	3·52	2·34	1·76	1·40	1·17	1·00	·87	·78	·70	·63	·58	·53	·49	·46
7	32·2	4·08	8·05	4·02	2·68	2·01	1·61	1·34	1·14	1·00	·89	·80	·72	·66	·61	·56	·52
8	36·3	4·10	9·07	4·54	3·02	2·27	1·81	1·51	1·29	1·13	1·00	·90	·81	·75	·69	·64	·59
9	40·4	4·12	10·1	5·05	3·36	2·52	2·02	1·68	1·44	1·25	1·11	1·00	·91	·83	·76	·71	·66
10	44·5	4·15	11·1	5·57	3·71	2·78	2·22	1·85	1·58	1·38	1·23	1·10	1·00	·91	·84	·78	·73
11	48·7	4·18	12·2	6·09	4·06	3·04	2·43	2·02	1·73	1·51	1·34	1·21	1·09	1·00	·92	·85	·79
12	52·9	4·21	13·2	6·61	4·41	3·30	2·64	2·20	1·88	1·64	1·46	1·31	1·19	1·09	1·00	·93	·86
13	57·1	4·25	14·3	7·14	4·76	3·57	2·85	2·37	2·03	1·77	1·57	1·41	1·28	1·17	1·08	1·00	·93
14	61·4	4·29	15·4	7·67	5·11	3·83	3·06	2·55	2·18	1·91	1·69	1·52	1·38	1·26	1·16	1·07	1·00
15	65·7	4·33	16·4	8·21	5·47	4·10	3·28	2·73	2·34	2·04	1·81	1·63	1·48	1·35	1·24	1·15	1·07
16	70·1	4·37	17·5	8·75	5·83	4·37	3·49	2·91	2·49	2·18	1·93	1·73	1·57	1·44	1·32	1·23	1·14
17	74·5	4·42	18·6	9·30	6·20	4·65	3·71	3·09	2·65	2·31	2·05	1·84	1·67	1·53	1·41	1·30	1·21
18	78·9	4·47	19·7	9·86	6·57	4·92	3·94	3·28	2·80	2·45	2·17	1·95	1·77	1·62	1·49	1·38	1·29
19	83·4	4·53	20·9	10·4	6·94	5·21	4·16	3·46	2·96	2·59	2·30	2·06	1·87	1·71	1·58	1·46	1·36
20	88·0	4·59	22·0	11·0	7·32	5·49	4·39	3·65	3·13	2·73	2·42	2·18	1·97	1·81	1·66	1·54	1·43
21	92·6	4·65	23·1	11·6	7·71	5·78	4·62	3·84	3·29	2·87	2·55	2·29	2·08	1·90	1·75	1·62	1·51
22	97·3	4·72	24·3	12·2	8·10	6·07	4·85	4·04	3·46	3·02	2·68	2·41	2·18	2·00	1·84	1·70	1·58
23	102·0	4·79	25·5	12·7	8·50	6·37	5·09	4·24	3·63	3·17	2·81	2·53	2·29	2·09	1·93	1·79	1·66
24	106·9	4·87	26·7	13·4	8·90	6·67	5·33	4·44	3·80	3·32	2·94	2·64	2·40	2·19	2·02	1·87	1·74
25	111·8	4·95	27·9	14·0	9·31	6·97	5·57	4·64	3·97	3·47	3·08	2·77	2·51	2·29	2·11	1·96	1·82
26	116·8	6·04	29·2	14·6	9·72	7·29	5·82	4·85	4·15	3·63	3·22	2·89	2·62	2·40	2·21	2·04	1·90
27	121·9	5·13	30·5	15·2	10·1	7·60	6·08	5·06	4·33	3·78	3·36	3·02	2·74	2·50	2·30	2·13	1·98
28	127·0	6·23	31·8	15·9	10·6	7·93	6·34	5·27	4·51	3·94	3·50	3·14	2·85	2·61	2·40	2·22	2·07
29	132·3	5·33	33·1	16·5	11·0	8·26	6·60	5·49	4·70	4·11	3·65	3·27	2·97	2·72	2·50	2·32	2·15
30	137·7	5·44	34·4	17·2	11·5	8·59	6·87	5·72	4·89	4·28	3·79	3·41	3·09	2·83	2·60	2·41	2·24
31	143·2	6·55	35·8	17·9	11·9	8·94	7·14	5·95	5·09	4·45	3·95	3·54	3·21	2·94	2·71	2·51	2·33
32	148·8	5·69	37·2	18·6	12·4	9·29	7·42	6·18	5·29	4·62	4·10	3·68	3·34	3·06	2·81	2·60	2·42
33	154·6	5·82	38·6	19·3	12·9	9·65	7·71	6·42	5·49	4·80	4·26	3·83	3·47	3·17	2·92	2·71	2·52
34	160·5	6·96	40·1	20·1	13·4	10·0	8·00	6·66	5·70	4·98	4·42	3·97	3·60	3·29	3·03	2·81	2·61
35	166·5	6·11	41·6	20·8	13·9	10·4	8·30	6·91	5·92	5·17	4·59	4·12	3·74	3·42	3·15	2·91	2·71
36	172·7	6·27	43·2	21·6	14·4	10·8	8·61	7·17	6·14	5·36	4·76	4·27	3·88	3·55	3·26	3·02	2·81
37	179·1	6·44	44·8	22·4	14·9	11·2	8·93	7·43	6·36	5·56	4·93	4·43	4·02	3·68	3·38	3·13	2·92
38	185·6	6·62	46·4	23·2	15·5	11·6	9·26	7·70	6·60	5·76	5·11	4·59	4·17	3·81	3·51	3·25	3·02
39	192·3	6·82	48·1	24·0	16·0	12·0	9·59	7·98	6·83	5·97	5·30	4·76	4·32	3·95	3·63	3·37	3·13
40	199·2	7·03	49·8	24·9	16·6	12·4	9·94	8·27	7·08	6·19	5·49	4·93	4·47	4·09	3·77	3·49	3·24
41	206·4	7·26	51·6	25·8	17·2	12·9	10·3	8·57	7·33	6·41	5·68	5·11	4·63	4·24	3·90	3·61	3·36
42	213·7	7·48	53·4	26·7	17·8	13·3	10·7	8·87	7·59	6·64	5·89	5·29	4·80	4·39	4·04	3·74	3·48
43	221·3	7·73	55·3	27·7	18·4	13·8	11·0	9·19	7·86	6·87	6·10	5·48	4·97	4·54	4·18	3·87	3·60
44	229·2	8·00	57·3	28·6	19·1	14·3	11·4	9·51	8·14	7·12	6·31	5·67	5·14	4·70	4·33	4·01	3·73
45	237·3	8·29	59·3	29·7	19·8	14·8	11·8	9·85	8·43	7·37	6·54	5·87	5·33	4·87	4·49	4·15	3·86
46	245·8	8·60	61·4	30·7	20·5	15·3	12·3	10·2	8·73	7·63	6·77	6·08	5·52	5·05	4·64	4·30	4·00
47	254·5	8·93	63·6	31·8	21·2	15·9	12·7	10·6	9·05	7·90	7·01	6·30	5·71	5·23	4·81	4·45	4·14
48	263·6	9·30	65·9	32·9	22·0	16·5	13·1	10·9	9·37	8·19	7·26	6·52	5·92	5·41	4·98	4·61	4·29
49	273·1	9·69	68·3	34·1	22·7	17·0	13·6	11·3	9·71	8·48	7·52	6·76	6·13	5·61	5·16	4·78	4·45
50	283·0	10·1	70·7	35·4	23·6	17·7	14·1	11·7	10·1	8·79	7·80	7·00	6·35	5·81	5·35	4·95	4·61
51	293·3	10·6	73·3	36·7	24·4	18·3	14·6	12·2	10·4	9·11	8·08	7·26	6·58	6·02	5·54	5·13	4·78
52	304·1	11·1	76·0	38·0	25·3	19·0	15·2	12·6	10·8	9·44	8·38	7·53	6·83	6·24	5·75	5·32	4·95
53	315·4	11·6	78·9	39·4	26·3	19·7	15·7	13·1	11·2	9·79	8·69	7·81	7·08	6·48	5·96	5·52	5·14
54	327·3	12·2	81·8	40·9	27·3	20·4	16·3	13·6	11·6	10·2	9·02	8·10	7·35	6·72	6·19	5·73	5·33
55	339·8	12·8	84·9	42·5	28·3	21·2	16·9	14·1	12·1	10·5	9·36	8·41	7·63	6·97	6·42	5·95	5·53
56	352·9	13·5	88·2	44·1	29·4	22·0	17·6	14·7	12·5	11·0	9·72	8·73	7·92	7·24	6·67	6·18	5·75
57	366·8	14·3	91·7	45·8	30·5	22·9	18·3	15·2	13·0	11·4	10·1	9·08	8·23	7·53	6·93	6·42	5·97
58	381·4	15·1	95·3	47·7	31·8	23·8	19·0	15·8	13·6	11·8	10·5	9·44	8·56	7·83	7·21	6·68	6·21
59	397·0	16·0	99·2	49·6	33·0	24·8	19·8	16·5	14·1	12·3	10·9	9·82	8·91	8·15	7·50	6·95	6·46
60	m. 59	..	m. 56	m. 52	m. 48	m 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	11 HOURS.																

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	Var. to 1′ of Decl.	0 HOURS. m. 1	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 26	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56
°	″	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	4·00	·0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	4·00	4·0	1·00	·50	·33	·25	·20	·17	·14	·13	·11	·10	·09	·08	·08	·07
2	4·01	8·0	2·00	1·00	·67	·50	·40	·33	·29	·25	·22	·20	·18	·17	·16	·14
3	4·01	12·0	3·00	1·50	1·00	·75	·60	·50	·43	·38	·34	·30	·27	·25	·23	·22
4	4·02	16·0	4·01	2·00	1·34	1·00	·80	·67	·57	·50	·45	·40	·37	·34	·31	·29
5	4·03	20·1	5·01	2·51	1·67	1·25	1·00	·84	·72	·63	·56	·50	·46	·42	·39	·36
6	4·05	24·1	6·02	3·01	2·01	1·51	1·21	1·01	·86	·76	·67	·61	·55	·51	·47	·43
7	4·06	28·1	7·04	3·52	2·35	1·76	1·41	1·17	1·01	·88	·78	·71	·64	·59	·55	·51
8	4·08	32·2	8·05	4·03	2·69	2·01	1·61	1·34	1·15	1·01	·90	·81	·74	·68	·62	·58
9	4·10	36·3	9·08	4·54	3·03	2·27	1·82	1·52	1·30	1·14	1·01	·91	·83	·76	·70	·65
10	4·12	40·4	10·1	5·05	3·37	2·53	2·02	1·69	1·45	1·27	1·13	1·02	·92	·85	·78	·73
11	4·15	44·5	11·1	5·57	3·71	2·79	2·23	1·86	1·59	1·40	1·24	1·12	1·02	·93	·86	·80
12	4·18	48·7	12·2	6·09	4·06	3·05	2·44	2·03	1·74	1·53	1·36	1·22	1·11	1·02	·94	·88
13	4·21	52·9	13·2	6·62	4·41	3·31	2·65	2·21	1·89	1·66	1·48	1·33	1·21	1·11	1·03	·95
14	4·25	57·1	14·3	7·14	4·76	3·57	2·86	2·39	2·05	1·79	1·59	1·44	1·31	1·20	1·11	1·03
15	4·29	61·4	15·4	7·68	5·12	3·84	3·07	2·56	2·20	1·93	1·71	1·54	1·40	1·29	1·19	1·11
16	4·33	65·7	16·4	8·22	5·48	4·11	3·29	2·74	2·35	2·06	1·83	1·65	1·50	1·38	1·27	1·19
17	4·37	70·1	17·5	8·76	5·84	4·38	3·51	2·92	2·51	2·20	1·95	1·76	1·60	1·47	1·36	1·26
18	4·42	74·5	18·6	9·31	6·21	4·66	3·73	3·11	2·67	2·33	2·08	1·87	1·70	1·56	1·44	1·34
19	4·47	78·9	19·7	9·87	6·58	4·94	3·95	3·29	2·83	2·47	2·20	1·98	1·80	1·66	1·53	1·42
20	4·53	83·4	20·9	10·4	6·95	5·22	4·18	3·48	2·99	2·62	2·33	2·10	1·91	1·75	1·62	1·50
21	4·59	88·0	22·0	11·0	7·33	5·50	4·40	3·67	3·15	2·76	2·45	2·21	2·01	1·85	1·71	1·59
22	4·65	92·6	23·2	11·6	7·72	5·79	4·64	3·87	3·32	2·90	2·58	2·33	2·12	1·94	1·80	1·67
23	4·72	97·3	24·3	12·2	8·11	6·09	4·87	4·06	3·48	3·05	2·71	2·44	2·22	2·04	1·89	1·75
23° 28′	4·75	99·5	24·9	12·4	8·29	6·22	4·98	4·15	3·56	3·12	2·78	2·50	2·28	2·09	1·93	1·79
24	4·79	102·0	25·5	12·8	8·51	6·38	5·11	4·26	3·65	3·20	2·85	2·56	2·33	2·14	1·98	1·84
25	4·87	106·9	26·7	13·4	8·91	6·68	5·35	4·46	3·83	3·35	2·98	2·69	2·44	2·24	2·07	1·93
26	4·95	111·8	27·9	14·0	9·32	6·99	5·60	4·67	4·00	3·50	3·12	2·81	2·56	2·35	2·17	2·02
27	5·04	116 8	29·2	14·6	9·74	7·30	5·85	4·87	4·18	3·66	3·26	2·93	2·67	2·45	2·27	2·11
28	5·13	121·9	30·5	15·2	10·2	7·62	6·10	5·09	4·36	3·82	3·40	3·06	2·79	2·56	2·36	2·20
29	5·23	127·0	31·8	15·9	10·6	7·95	6·36	5·30	4·55	3·98	3·54	3·19	2·91	2·67	2·46	2·29
30	5·33	132·3	33·1	16·5	11·0	8·28	6·62	5·52	4·74	4·15	3·69	3·32	3·03	2·78	2·57	2·39
Names of Stars.																
N. Decln. Stars.																
Procyon ..		21·9	5·47	2·74	1·83	1·37	1·10	91	·78	·69	·61	·55	·50	·46	·42	·39
Altair ..		34·8	8·69	4·35	2·90	2·18	1·74	1·45	1·25	1·09	·97	·87	·80	·73	·67	·63
Aldebaran ..		67·1	16·8	8·39	5·60	4·20	3·36	2·80	2·40	2·11	1·87	1·69	1·54	1·41	1·30	1·21
Arcturus ..		81·9	20·5	10·2	6·82	5·12	4·10	3·42	2·93	2·57	2·28	2·06	1·87	1·72	1·59	1·48
Castor ..		143·7	35·9	17·8	12·0	8·99	7·19	6·00	5·14	4·51	4·01	3·61	3·29	3·02	2·79	2·59
Vega ..		183·6	45·9	23·0	15·3	11·5	9·19	7·66	6·57	5·76	5·12	4·61	4·20	3·85	3·56	3·31
Deneb ..		228·9	57·2	28·6	19·1	14·3	11·5	9·55	8·19	7·17	6·38	5·75	5·23	4·80	4·44	4·13
Capella ..		236·6	59·1	29·6	19·7	14·8	11·8	9·87	8·47	7·42	6·60	5·94	5·41	4·96	4·59	4·27
α Persei ..		268·7	67·2	33·6	22·4	16·8	13·5	11·2	9·62	8·43	7·50	6·75	6·15	5·64	5·21	4·85
η Ursæ Majoris		270·8	67·7	33·9	22·6	16·9	13·6	11·3	9·70	8·49	7·55	6·81	6·19	5·68	5·25	4·89
ε Ursæ Majoris		345·6	86·4	43·2	28·8	21·6	17·3	14·4	12·4	10·8	9·64	8·68	7·90	7·25	6·70	6·23
α Ursæ Majoris		435·4	109	54·4	36·3	27·2	21·8	18·2	15·6	13·6	12·1	10·9	9·96	9·14	8·44	7·85
S. Decln. Stars.																
Rigel ..		33·5	8·36	4·18	2·79	2·09	1·67	1·40	1·20	1·05	·93	·84	·77	·70	·65	·60
Sirius ..		68·3	17·1	8·54	5·69	4·27	3·42	2·85	2·44	2·14	1·91	1·72	1·56	1·43	1·32	1·23
ε Sagittarii ..		157·1	39·3	19·6	13·1	9·83	7·86	6·56	5·62	4·92	4·38	3·95	3·59	3·30	3·05	2·83
λ Scorpii ..		172·9	43·2	21·6	14·4	10·8	8·66	7·22	6·19	5·42	4·82	4·35	3·95	3·63	3·35	3·12
γ Argûs ..		246·4	61·6	30·8	20·5	15·4	12·3	10·3	8·82	7·72	6·87	6·19	5·63	5·17	4·78	4·44
α Gruis ..		249·2	62·3	31·2	20·8	15·6	12·5	10·4	8·92	7·81	6·95	6·26	5·70	5·23	4·83	4·49
Canopus ..		300·3	75·1	37·5	25·0	18·8	15·0	12·5	10·8	9·41	8·38	7·54	6·87	6·30	5·82	5·42
γ Crucis ..		347·7	86·9	43·5	29·0	21·7	17·4	14·5	12·4	10·9	9·70	8·74	7·95	7·30	6·74	6·27
α Pavonis ..		353·2	88·3	44·2	29·4	22·1	17·7	14·7	12·6	11·1	9·85	8·88	8·08	7·41	6·85	6·37
Achernar ..		362·4	90·6	45·3	30·3	22·7	18·1	15·1	13·0	11·4	10·1	9·11	8·29	7·61	7·03	6·54
β Crucis or ε Argûs		384·6	96·2	48·1	32·1	24·1	19·3	16·1	13·8	12·1	10·7	9·66	8·79	8·07	7·46	6·94
β Centauri ..		396·0	99·0	49·5	33·0	24·8	19·8	16·5	14·2	12·4	11·0	9·95	9·06	8·31	7·68	7·14
α^2 Centauri ..		404·5	101	50·6	33·7	25·3	20·2	16·9	14·5	12·7	11·3	10·2	9·25	8·49	7·85	7·30
α^1 Crucis ..		442·1	111	55·3	36·9	27·7	22·1	18·5	15·8	13·9	12·3	11·1	10·1	9·28	8·58	7·97
α Trianguli Aus.		592·8	148	74·1	49·4	37·1	29·7	24·7	21·2	18·6	16·5	14·9	13·6	12·4	11·5	10·7
β Argûs ..		608·0	152	76·0	50·7	38·0	30·4	25·4	21·8	19·1	17·0	15·3	13·9	12·8	11·8	11 0
		m. 59	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4
		11 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	1 HOUR.															2 Hr.
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	·07	·06	·06	·05	·05	·05	·05	·04	·04	·04	·04	·04	·03	·03	·03	·03
2	·13	·12	·11	·11	·10	·10	·09	·09	·08	·08	·07	·07	·07	·07	·06	·06
3	·20	·18	·17	·16	·15	·14	·14	·13	·12	·12	·11	·11	·10	·10	·09	·09
4	·26	·24	·23	·22	·20	·19	·18	·17	·16	·16	·15	·14	·14	·13	·13	·12
5	·33	·31	·29	·27	·25	·24	·23	·22	·21	·20	·19	·18	·17	·16	·16	·15
6	·39	·37	·34	·32	·31	·29	·27	·26	·25	·24	·23	·22	·21	·20	·19	·18
7	·46	·43	·40	·38	·36	·34	·32	·30	·29	·28	·26	·25	·24	·23	·22	·21
8	·52	·49	·46	·43	·41	·39	·37	·35	·33	·32	·30	·29	·28	·26	·25	·24
9	·59	·55	·52	·49	·46	·44	·41	·39	·37	·36	·34	·32	·31	·30	·29	·27
10	·66	·61	·58	·54	·51	·48	·46	·44	·42	·40	·38	·36	·35	·33	·32	·31
11	·73	·68	·64	·60	·56	·53	·51	·48	·46	·44	·42	·40	·38	·37	·35	·34
12	·79	·74	·70	·65	·62	·58	·55	·53	·50	·48	·46	·44	·42	·40	·38	·37
13	·86	·81	·76	·71	·67	·63	·60	·57	·54	·52	·50	·47	·45	·43	·42	·40
14	·93	·87	·82	·77	·72	·69	·65	·62	·59	·56	·53	·51	·49	·47	·45	·43
15	1·00	·93	·88	·82	·78	·74	·70	66	·63	·60	·57	·55	·53	·50	48	·46
16	1·07	1·00	·94	·88	·83	79	·75	71	·68	·64	·61	·59	·56	·54	·52	·50
17	1·14	1·07	1·00	·94	·89	·84	·80	·76	·72	·69	·66	·63	·60	·57	·55	·53
18	1·21	1·13	1·06	1·00	·94	·89	85	80	·77	·73	·70	·67	·64	·61	·59	·56
19	1·29	1·20	1·13	1·06	1·00	·95	90	·85	·81	·77	·74	·71	·68	·65	·62	·60
20	1·36	1·27	1·19	1·12	1·06	1·00	·95	·90	·86	·82	·78	·75	·71	·68	·66	·63
21	1·43	1·34	1·26	1·18	1·11	1·05	1·00	·95	·90	·86	·82	·79	·75	·72	·69	·66
22	1·51	1·41	1·32	1·24	1·17	1·11	1·05	1·00	·95	·91	·87	·83	·79	·76	·73	·70
23	1·58	1·48	1·39	1·31	1·23	1·17	1·11	1·05	1·00	·95	·91	·87	·83	·80	·77	·74
24	1·66	1·55	1·46	1·37	1·29	1·22	1·16	1·10	1·05	1·00	·95	·91	·87	·84	·80	·77
25	1·74	1·63	1·53	1·44	1·35	1·28	1·21	1·15	1·10	1·05	1·00	·96	·92	·88	·84	·81
26	1·82	1·70	1·60	1·50	1·42	1·34	1·27	1·21	1·15	1·10	1·05	1·00	96	·92	88	·84
27	1·90	1·78	1·67	1·57	1·48	1·40	1·33	1·26	1·20	1·14	1·09	1·04	1·00	·96	·92	·88
28	1·98	1·85	1·74	1·64	1·54	1·46	1·39	1·32	1·25	1·19	1·14	1·09	1·04	1·00	·96	·92
29	2·07	1·93	1·81	1·71	1·61	1·52	1·44	1·37	1·31	1·24	1·19	1·14	1·09	1·04	1·00	·96
30	2·15	2·01	1·89	1·78	1·68	1·59	1·50	1·43	1·36	1·30	1·24	1·18	1·13	1·09	1·04	1·00
31	2·24	2·10	1·97	1·85	1·75	1·65	1·57	1·49	1·42	1·35	1·29	1·23	1·18	1·13	1·08	1·04
32	2·33	2·18	2·04	1·92	1·81	1·72	1·63	1·55	1·47	1·40	1·34	1·28	1·23	1·18	1·13	1·08
33	2·42	2·26	2·12	2·00	1·89	1·78	1·69	1·61	1·53	1·46	1·39	1·33	1·27	1·22	1·17	1·12
34	2·52	2·35	2·21	2·08	1·96	1·85	1·76	1·67	1·59	1·51	1·45	1·38	1·32	1·27	1·22	1·17
35	2·61	2·44	2·29	2·16	2·03	1·92	1·82	1·73	1·65	1·57	1·50	1·44	1·37	1·32	1·26	1·21
36	2·71	2·53	2·38	2·24	2·11	2·00	1·89	1·80	1·71	1·63	1·56	1·49	1·43	1·37	1·31	1·26
37	2·81	2·63	2·46	2·32	2·19	2·07	1·96	1·87	1·78	1·69	1·62	1·55	1·48	1·42	1·36	1·31
38	2·92	2·72	2·56	2·40	2·27	2·15	2·04	1·93	1·84	1·75	1·68	1·60	1·53	1·47	1·41	1·35
39	3·02	2·82	2·65	2·49	2·35	2·22	2·11	2·00	1·91	1·82	1·74	1·66	1·59	1·52	1·46	1·40
40	3·13	2·93	2·74	2·58	2·44	2·31	2·19	2·08	1·98	1·88	1·80	1·72	1·65	1·58	1·51	1·45
41	3·24	3·03	2·84	2·68	2·52	2·39	2·26	2·15	2·05	1·95	1·86	1·78	1·71	1·63	1·57	1·51
42	3·36	3·14	2·95	2·77	2·61	2·47	2·35	2·23	2·12	2·02	1·93	1·85	1·77	1·69	1·62	1·56
43	3·48	3·25	3·05	2·87	2·71	2·56	2·43	2·31	2·20	2·09	2·00	1·91	1·83	1·75	1·68	1·62
44	3·60	3·37	3·16	2·97	2·80	2·65	2·52	2·39	2·28	2·17	2·07	1·98	1·90	1·82	1·74	1·67
45	3·73	3·49	3·27	3·08	2·90	2·75	2·61	2·48	2·36	2·25	2·14	2·05	1·96	1·88	1·80	1·73
46	3·86	3·61	3·39	3·19	3·01	2·85	2·70	2·56	2·44	2 33	2·22	2·12	2·03	1·95	1·87	1·79
47	4·00	3·74	3·51	3·30	3·11	2·95	2·79	2·65	2·53	2·41	2·30	2·20	2·10	2·02	1·93	1·86
48	4·14	3·87	3·63	3·42	3·23	3·05	2·89	2·75	2·62	2·49	2·38	2·28	2·18	2·09	2·00	1·92
49	4·29	4·01	3·76	3·54	3·34	3·16	3·00	2·85	2·71	2·58	2·47	2·36	2·26	2·16	2·08	1·99
50	4·45	4·16	3·90	3·67	3·46	3·27	3·10	2·95	2·81	2·68	2·56	2·44	2·34	2·24	2·15	2·06
51	4·61	4·31	4·04	3·80	3·59	3·39	3·22	3·06	2·91	2·77	2·65	2·53	2·42	2·32	2·23	2·14
52	4·78	4·46	4·19	3·94	3·72	3·52	3·33	3·17	3·02	2·87	2·74	2·62	2·51	2·41	2·31	2·22
53	4·95	4·63	4·34	4·08	3·85	3·65	3·46	3·28	3·13	2·98	2·85	2·72	2·60	2·50	2·39	2·30
54	5·14	4·80	4·50	4·24	4·00	3·78	3·59	3·41	3·24	3·09	2·95	2·82	2·70	2·59	2·48	2·38
55	5·33	4·98	4·67	4·40	4·15	3·92	3·72	3·53	3·36	3·21	3·06	2·93	2·80	2·69	2·58	2·47
56	5·53	5·17	4·85	4·56	4·31	4·07	3·86	3·67	3·49	3·33	3·18	3·04	2·91	2·79	2·67	2·57
57	5·75	5·37	5·04	4·74	4·47	4·23	4·01	3·81	3·63	3·46	3·30	3·16	3·02	2·90	2·78	2·67
58	5·97	5·58	5·23	4·93	4·65	4·40	4·17	3·96	3·77	3·59	3·43	3·28	3·14	3·01	2·89	2·77
59	6·21	5·80	5·44	5·12	4·83	4·57	4·34	4·12	3·92	3·74	3·57	3·41	3·27	3·13	3·00	2·88
60	6·46	6·04	5·67	5·33	5·03	4·76	4·51	4·29	4·08	3·89	3·71	3·55	3·40	3·26	3·12	3·00
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	11 HR.	10 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of latitude

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	1 HOUR.															2 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	00
1	·07	·06	·06	·06	·05	·05	·05	·05	·04	·04	·04	·04	·04	·04	·04	·03
2	·13	·13	·12	·11	·11	·10	·10	·09	·09	·09	·08	·08	·08	·07	·07	·07
3	·20	·19	·18	·17	·16	·15	·15	·14	·13	·13	·12	·12	·12	·11	·11	·10
4	·27	·25	·24	·23	·21	·20	·20	·19	·18	·17	·17	·16	·15	·15	·14	·14
5	·34	·32	·30	·28	·27	·26	·24	·23	·22	·22	·21	·20	·19	·19	·18	·17
6	·41	·38	·36	·34	·32	·31	·29	·28	·27	·26	·25	·24	·23	·22	·22	·21
7	·47	·45	·42	·40	·38	·36	·34	·33	·31	·30	·29	·28	·27	·26	·25	·25
8	·54	·51	·48	·45	·43	·41	·39	·38	·36	·35	·33	32	·31	·30	·29	·28
9	·61	·57	·54	·51	·49	·46	·44	·42	·41	·39	·37	·36	·35	·34	·33	·32
10	·68	·64	·60	·57	·54	·52	·49	·47	·45	·43	·42	·40	·39	·38	·36	·35
11	·75	·71	·66	·63	·60	·57	·54	·52	·50	·48	·46	·44	·43	·41	·40	·39
12	·82	·77	·73	·69	·65	·62	·59	·57	·54	·52	·50	·48	·47	·45	·44	·43
13	·89	·84	·79	·75	·71	·68	·64	·62	·59	·57	·55	·53	·51	·49	·48	·46
14	·96	·90	·85	·81	·77	·73	·70	·67	·64	·61	·59	·57	·55	·53	·51	·50
15	1·04	·97	·92	·87	·82	·78	·75	·72	·69	·66	·63	·61	·59	·57	·55	·54
16	1·11	1·04	·98	·93	·88	·84	·80	·77	·73	·70	·68	·65	·63	·61	·59	·57
17	1·18	1·11	1·05	·99	·94	·89	·85	·82	·78	·75	·72	·70	·67	·65	·63	·61
18	1·26	1·18	1·11	1·05	1·00	·95	·91	·87	·83	·80	·77	·74	·72	·69	·67	·65
19	1·33	1·25	1·18	1·11	1·06	1·01	·96	·92	·88	·85	·81	·79	·76	·73	·71	·69
20	1·41	1·32	1·24	1·18	1·12	1·06	1·02	·97	·93	·89	·86	·83	·80	·78	·75	·73
21	1·48	1·39	1·31	1·24	1·18	1·12	1·07	1·02	·98	·94	91	·88	·85	·82	·79	·77
22	1·56	1·47	1·38	1·31	1·24	1·18	1·13	1·08	1·03	·99	·96	·92	·89	·86	·83	·81
23	1·64	1·54	1·45	1·37	1·30	1·24	1·18	1·13	1·09	1·04	1·00	·97	·93	·90	·88	·85
23° 28′	1·68	1·57	1·48	1·40	1·33	1·27	1·21	1·16	1·11	1·07	1·03	·99	·96	·92	·90	·87
24	1·72	1·62	1·52	1·44	1·37	1·30	1·24	1·19	1·14	1·09	1·05	1·02	·98	·95	·92	·89
25	1·80	1·69	1·59	1·51	1·43	1·36	1·30	1·24	1·19	1·15	1·10	1·06	1·03	·99	·96	·93
26	1·88	1·77	1·67	1·58	1·50	1·43	1·36	1·30	1·25	1·20	1·15	1·11	1·07	1·04	1·01	·98
27	1·97	1·85	1·74	1·65	1·57	1·49	1·42	1·36	1·30	1·25	1·21	1·16	1·12	1·09	1·05	1·02
28	2·05	1·93	1·82	1·72	1·63	1·55	1·48	1·42	1·36	1·31	1·26	1·21	1·17	1·13	1·10	1·06
29	2·14	2·01	1·90	1·79	1·70	1·62	1·55	1·48	1·42	1·36	1·31	1·26	1·22	1·18	1·14	1·11
30	2·23	2·09	1·97	1·87	1·77	1·69	1·61	1·54	1·48	1·42	1·37	1·32	1·27	1·23	1·19	1·15
Stars. *N. Decln.*																
Procyon	·37	·35	·33	·31	·29	·28	·27	·26	·24	·23	·23	·22	·21	·20	·20	·19
Altair ..	·59	·55	·52	·49	·47	·45	·42	·41	·39	·37	·36	·35	·33	·32	**·31**	·31
Aldebar'n	1·13	1·06	1·00	·95	·90	·86	·82	·78	·75	·72	·69	·67	·65	·62	·60	·59
Arcturus	1·38	1·30	1·22	1·16	1·10	1·04	1·00	·95	·91	·88	·84	·81	·79	·76	·74	·71
Castor ..	2·42	2·27	2·14	2·03	1·93	1·83	1·75	1·67	1·60	1·54	1·48	1·43	1·38	1·34	1·29	1·25
Vega ..	3·10	2·91	2·74	2·59	2·46	**2**·34	2·24	2·14	2·05	1·97	1·90	1·83	1·76	1·71	1·65	1·60
Deneb ..	3·86	3·62	3·42	3·23	3·07	2·92	2·79	2·67	2·56	2·46	2·36	2·28	2·20	2·13	2·06	2·00
Capella	3·99	3·74	3·53	3·34	3·17	3·02	2·88	2·76	2·64	2·54	2·44	2·35	2·27	2·20	2·13	2·06
α Persei ..	4·53	4·25	4·01	3·79	3·60	3·43	3·27	3·13	3·00	2·88	2·77	2·67	2·58	2·50	2·42	2·35
η Ursæ Maj.	4·57	4·29	4·04	3·82	3·63	3·46	3·29	3·15	3·02	2·90	2·80	2·70	2·60	2·52	2·44	2·36
ε Ursæ Maj.	5·83	5·47	5·16	4·88	4·63	4·41	4·21	4·03	3·86	3·71	3·57	3·44	3·32	3·21	3·11	3·02
α Ursæ Maj.	7·34	6·89	6·50	6·15	5·83	5·55	5·30	5·07	4·86	4·67	4·50	4·33	4·18	4·05	3·92	3·80
S. Decln.																
Rigel ..	·56	·53	·49	·47	·45	·43	·41	·39	·37	·36	·35	·33	·32	·31	·30	·29
Sirius ..	1·15	1·08	1·02	·96	·92	·87	·83	·80	·76	·73	·71	·68	66	·63	·61	·60
ϵ Sagittarii	2·65	2·49	2·34	2·22	2·11	2·00	1·91	1·83	1·75	1·68	1·62	1·56	1·51	1·46	1·41	1·37
λ Scorpii	2·92	2·74	2·58	2·44	3·32	2·21	2·11	2·01	1·93	1·86	1·79	1·72	1·66	1·61	1·56	1·51
γ Argûs ..	4·15	3·90	3·68	3·48	3·30	3·14	3·00	2·87	2·75	2·64	2·54	2·45	2·37	2·29	2·22	1·15
α Gruis ..	4·20	3·94	3·72	3·52	3·34	3·18	3·03	2·90	2·78	2·67	2·57	2·48	2·40	2·32	2·24	2·17
Canopus	5·06	4·75	4·48	4·24	4·02	3·83	3·66	3·50	3·35	3·22	3·10	2·99	2·89	2·79	2·70	2·62
γ Crucis ..	5·86	5·50	5·19	4·91	4·66	4·44	4·23	4·05	3·88	3·73	3·59	3·46	3·34	3·23	3·13	3·03
α Pavonis	5·96	5·59	5·27	4·99	4·73	4·51	4·30	4·11	3·94	3·79	3·65	3·52	3·40	3·28	3·18	3·08
Achernar	6·11	5·74	5·41	5·12	4·86	4·62	4·41	4·22	4·05	3·89	3·74	3·61	3·48	3·37	3·26	3·16
β Crucis / ϵ Argûs	6·48	6·09	5·74	5·43	5·15	4·91	4·68	4·48	4·29	4·13	3·97	3·83	3·70	3·57	3·46	3·36
β Centauri	6·68	6·27	5·91	5·59	5·31	5·05	4·82	4·61	4·42	4·25	4·09	3·94	3·81	3·68	3·56	3·46
α^2 Centauri	6·82	6·40	6·04	5·71	5·42	5·16	4·92	4·71	4·52	4·34	4·18	4·03	3·89	3·76	3·64	3·53
α^1 Crucis ..	7·45	7·00	6·60	6·24	5·93	5·64	5·38	5·15	4·93	4·74	4·57	4·40	4·25	4·11	3·98	3·86
α Tri. Aus.	9·99	9·38	8·85	8·37	7·95	7·56	7·22	6·91	6·62	6·36	6·12	5·90	5·70	5·51	5·34	5·17
β Argûs ..	10·25	9·62	9·07	8·59	8·15	7·75	7·40	7·08	6·79	6·52	6·28	6·05	5·84	5·65	5·47	5·31
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	11 Hr.	10 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	2 HOURS.															3 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 58	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	·03	·03	·03	·03	·03	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02
2	·06	·06	·06	·05	·05	·05	·05	·05	·04	·04	·04	·04	·04	·04	·04	·03
3	·09	·09	·08	·08	·08	·07	·07	·07	·07	·06	·06	·06	·06	·06	·05	·05
4	·12	·12	·11	·11	·10	·10	·10	·09	·09	·09	·08	·08	·08	·07	·07	·07
5	·15	·15	·14	·13	·13	·12	·12	·12	·11	·11	·10	·10	·10	·09	·09	·09
6	·18	·17	·17	·16	·16	·15	·14	·14	·13	·13	·13	·12	·12	·11	·11	·11
7	·21	·20	·20	·19	·18	·18	·17	·16	·16	·15	·15	·14	·14	·13	·13	·12
8	·24	·23	·22	·22	·21	·20	·19	·19	·18	·17	·17	·16	·16	·15	·15	·14
9	·27	·26	·25	·24	·23	·23	·22	·21	·20	·20	·19	·18	·18	·17	·16	·16
10	·31	·29	·28	·27	·26	·25	·24	·23	·23	·22	·21	·20	·20	·19	·18	·18
11	·34	·32	·31	·30	·29	·28	·27	·26	·25	·24	·23	·22	·22	·21	·20	·19
12	·37	·35	·34	·33	·32	·30	·29	·28	·27	·26	·25	·24	·24	·23	·22	·21
13	·40	·38	·37	·36	·34	·33	·32	·31	·30	·29	·28	·27	·26	·25	·24	·23
14	·43	·41	·40	·38	·37	·36	·34	·33	·32	·31	·30	·29	·28	·27	·26	·25
15	·46	·45	·43	·41	·40	·38	·37	·36	·34	·33	·32	·31	·30	·29	·28	·27
16	·50	·48	·46	·44	·43	·41	·39	·38	·37	·35	·34	·33	·32	·31	·30	·29
17	·53	·51	·49	·47	·45	·44	·42	·41	·39	·38	·36	·35	·34	·33	·32	·31
18	·56	·54	·52	·50	·48	·46	·45	·43	·42	·40	·39	·37	·36	·35	·34	·32
19	·60	·57	·55	·53	·51	·49	·47	·46	·44	·43	·41	·40	·38	·37	·36	·34
20	·63	·61	·58	·56	·54	·52	·50	·48	·47	·45	·43	·42	·40	·39	·38	·36
21	·66	·64	·61	·59	·57	·55	·53	·51	·49	·47	·46	·44	·43	·41	·40	·38
22	·70	·67	·65	·62	·60	·58	·56	·54	·52	·50	·48	·46	·45	·43	·42	·40
23	·74	·71	·68	·65	·63	·61	·58	·56	·54	·52	·51	·49	·47	·46	·44	·42
24	·77	·74	·71	·69	·66	·64	·61	·59	·57	·55	·53	·51	·49	·48	·46	·45
25	·81	·78	·75	·72	·69	·67	·64	·62	·60	·58	·56	·54	·52	·50	·48	·47
26	·84	·81	·78	·75	·72	·70	·67	·65	·62	·60	·58	·56	·54	·52	·51	·49
27	·88	·85	·82	·78	·76	·73	·70	·68	·65	·63	·61	·59	·57	·55	·53	·51
28	·92	·88	·85	·82	·79	·76	·73	·71	·68	·66	·63	·61	·59	·57	·55	·53
29	·96	·92	·89	·85	·82	·79	·76	·74	·71	·68	·66	·64	·62	·59	·57	·55
30	1·00	·96	·92	·89	·86	·82	·79	·77	·74	·71	·69	·66	·64	·62	·60	·58
31	1·04	1·00	·96	·93	·89	·86	·83	80	77	·74	72	·69	·67	·64	·62	·60
32	1·08	1·04	1·00	·96	·93	·89	·86	·83	·80	·77	·74	·72	·69	·67	·65	·62
33	1·12	1·08	1·04	1·00	·96	·93	·89	·86	·83	·80	·77	·75	·72	·70	·67	·65
34	1·17	1·12	1·08	1·04	1·00	·96	·93	·90	·86	83	·80	·78	·75	·72	·70	·67
35	1·21	1·17	1·12	1·08	1·04	1·00	·96	·93	·90	86	·83	·81	·78	·75	·73	·70
36	1·26	1·21	1·16	1·12	1·08	1·04	1·00	·96	·93	·90	·87	·84	·81	·78	·75	·73
37	1·31	1·25	1·21	1·16	1·12	1 08	1·04	1·00	·96	·93	·90	·87	·84	·81	·78	·75
38	1·35	1·30	1·25	1·20	1·16	1·12	1·08	1·04	1·00	·96	·93	·90	·87	·84	·81	·78
39	1·40	1·35	1·30	1·25	1·20	1·16	1·11	1·07	1·04	1·00	·97	·93	·90	·87	·84	·81
40	1·45	1·40	1·34	1·29	1·24	1·20	1·15	1·11	1·07	1·04	1·00	·97	·93	·90	·87	·84
41	1·51	1·45	1·39	1·34	1·29	1·24	1·20	1·15	1·11	1·07	1·04	1·00	·97	·93	·90	·87
42	1·56	1·50	1·44	1·39	1·33	1·29	1·24	1·19	1·15	1·11	1·07	1·04	1·00	·97	·93	·90
43	1·62	1·55	1·49	1·44	1·38	1·33	1·28	1·24	1·19	1·15	1·11	1·07	1·04	1·00	·97	·93
44	1·67	1·61	1·55	1·49	1·43	1·38	1·33	1·28	1·24	1·19	1·15	1·11	1·07	1·04	1·00	·97
45	1·73	1·66	1·60	1·54	1·48	1·43	1·38	1·33	1·28	1·23	1·19	1·15	1·11	1·07	1·04	1·00
46	1·79	1·72	1·66	1·59	1·54	1·48	1·43	1·37	1·33	1·28	1·23	1·19	1·15	1·11	1·07	1·04
47	1·86	1·78	1·72	1·65	1·59	1·53	1·48	1·42	1·37	1·32	1·28	1·23	1·19	1·15	1·11	1·07
48	1·92	1·85	1·78	1·71	1·65	1·59	1·53	1·47	1·42	1·37	1·32	1·28	1·23	1·19	1·15	1·11
49	1·99	1·91	1·84	1·77	1·71	1·64	1·58	1·53	1·47	1·42	1·37	1·32	1·28	1·23	1·19	1·15
50	2·06	1·98	1·91	1·84	1·77	1·70	1·64	1·58	1·53	1·47	1·42	1·37	1·32	1·28	1·23	1·19
51	2·14	2·06	1·98	1·90	1·83	1·76	1·70	1·64	1·58	1·52	1·47	1·42	1·37	1·32	1·28	1·23
52	2·22	2·13	2·05	1·97	1·90	1·83	1·76	1·70	1·64	1·58	1·53	1·47	1·42	1·37	1·33	1·28
53	2·30	2·21	2·12	2·04	1·97	1·90	1·83	1·76	1·70	1·64	1·58	1·53	1·47	1·42	1·37	1·33
54	2·38	2·29	2·20	2·12	2·04	1·97	1·89	1·83	1·76	1·70	1·64	1·58	1·53	1·48	1·43	1·38
55	2·47	2·38	2·29	2·20	2·12	2·04	1·97	1·90	1·83	1·76	1·70	1·64	1·59	1·53	1·48	1·43
56	2·57	2·47	2·37	2·28	2·20	2·12	2·04	1·97	1·90	1·83	1·77	1·71	1·65	1·59	1·54	1·48
57	2·67	2·56	2·46	2·37	2·28	2·20	2·12	2·04	1·97	1·90	1·84	1·77	1·71	1·65	1·59	1·54
58	2·77	2·66	2·56	2·46	2·37	2·29	2·20	2·12	2·05	1·98	1·91	1·84	1·78	1·72	1·66	1·60
59	2·88	2·77	2·66	2·56	2·47	2·38	2·29	2·21	2·13	2·06	1·98	1·91	1·85	1·78	1·72	1·66
60	3·00	2·88	2·77	2·67	2·57	2·47	2·38	2·30	2·22	2·14	2·06	1·99	1·92	1·86	1·79	1·73
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	10 Hr.	9 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	2 HOURS.															3 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·02
2	·07	·07	·07	·06	·06	·06	·06	·06	·06	·06	·05	·05	·05	·05	·05	·05
3	·10	·10	·10	·10	·09	·09	·09	·09	·09	·08	·08	·08	·08	·08	·08	·07
4	·14	·14	·13	·13	·13	·12	·12	·12	·11	·11	·11	·11	·10	·10	·10	·10
5	·17	·17	·17	·16	·16	·15	·15	·15	·14	·14	·14	·13	·13	·13	·13	·12
6	·21	·20	·20	·19	·19	·18	·18	·17	·17	·17	·16	·16	·16	·15	·15	·15
7	·25	·24	·23	·23	·22	·21	·21	·20	·20	·20	·19	·19	·18	·18	·18	·17
8	·28	·27	·27	·26	·25	·25	·24	·23	·23	·22	·22	·21	·21	·21	·20	·20
9	·32	·31	·30	·29	·28	·28	·27	·26	·26	·25	·25	·24	·24	·23	·23	·22
10	·35	·34	·33	·32	·32	·31	·30	·29	·29	·28	·27	·27	·26	·26	·25	·25
11	·39	·38	·37	·36	·35	·34	·33	·32	·32	·31	·30	·30	·29	·29	·28	·27
12	·43	·41	·40	·39	·38	·37	·36	·35	·35	·34	·33	·32	·32	·31	·31	·30
13	·46	·45	·44	·42	·41	·40	·39	·38	·37	·37	·36	·35	·35	·34	·33	·33
14	·50	·48	·47	·46	·45	·43	·42	·41	·40	·40	·39	·38	·37	·37	·36	·35
15	·54	·52	·51	·49	·48	·47	·46	·45	·44	·43	·42	·41	·40	·39	·39	·38
16	·57	·56	·54	·53	·51	·50	·49	·48	·47	·46	·45	·44	·43	·42	·41	·41
17	·61	·59	·58	·56	·55	·53	·52	·51	·50	·49	·48	·47	·46	·45	·44	·43
18	·65	·63	·61	·60	·58	·57	·55	·54	·53	·52	·51	·50	·49	·48	·47	·46
19	·69	·67	·65	·63	·62	·60	·59	·57	·56	·55	·54	·52	·51	·50	·50	·49
20	·73	·71	·69	·67	·65	·63	·62	·60	·59	·58	·57	·55	·54	·53	·52	·51
21	·77	·75	·72	·70	·69	·67	·65	·64	·62	·61	·60	·59	·57	·56	·55	·54
22	·81	·78	·76	·74	·72	·70	·69	·67	·66	·64	·63	·62	·60	·59	·58	·57
23	·85	·82	·80	·78	·76	·74	·72	·71	·69	·67	·66	·65	·63	·62	·61	·60
23° 28′	·87	·84	·82	·80	·78	·76	·74	·72	·71	·69	·68	·66	·65	·64	·62	·61
24	·89	·86	·84	·82	·80	·78	·76	·74	·72	·71	·69	·68	·67	·65	·64	·63
25	·93	·91	·88	·86	·83	·81	·79	·77	·76	·74	·73	·71	·70	·68	·67	·66
26	·98	·95	·92	·90	·87	·85	·83	·81	·79	·78	·76	·74	·73	·72	·70	·69
27	1·02	·99	·96	·94	·91	·89	·87	·85	·83	·81	·79	·78	·76	·75	·73	·72
28	1·06	1·03	1·00	·98	·95	·93	·90	·88	·86	·84	·83	·81	·79	·78	·77	·75
29	1·11	1·08	1·05	1·02	·99	·97	·94	·92	·90	·88	·86	·84	·83	·81	·80	·78
30	1·15	1·12	1·09	1·06	1·03	1·01	·98	·96	·94	·92	·90	·88	·86	·85	·83	·82
Stars.																
N. Decln.																
Procyon	·19	·19	·18	·18	·17	·17	·16	·16	·16	·15	·15	·15	·14	·14	·14	·14
Altair ..	·31	·30	·29	·28	·27	·26	·26	·25	·25	·24	·24	·23	·23	·22	·22	·21
Aldebar'n	·59	·57	·55	·54	·52	·51	·50	·49	·48	·47	·46	·45	·44	·43	·42	·41
Arcturus	·71	·69	·67	·66	·64	·62	·61	·59	·58	·57	·56	·54	·53	·52	·51	·51
Castor ..	1·25	1·22	1·18	1·15	1·12	1·09	1·07	1·04	1·02	1·00	·98	·96	·94	·92	·90	·89
Vega ..	1·60	1·56	1·51	1·47	1·43	1·40	1·36	1·33	1·30	1·27	1·25	1·22	1·20	1·17	1·15	1·13
Deneb ..	2·00	1·94	1·88	1·83	1·79	1·74	1·70	1·66	1·62	1·59	1·55	1·52	1·49	1·46	1·44	1·41
Capella	2·06	2·00	1·95	1·90	1·85	1·80	1·76	1·72	1·68	1·64	1·61	1·57	1·54	1·51	1·49	1·46
α Persei ..	2·35	2·28	2·21	2·15	2·10	2·04	1·99	1·95	1·90	1·86	1·82	1·79	1·75	1·72	1·69	1·66
η Ursæ Maj.	2·36	2·29	2·23	2·17	2·11	2·06	2·01	1·96	1·92	1·88	1·84	1·80	1·77	1·73	1·70	1·67
ε Ursæ Maj.	3·02	2·93	2·85	2·77	2·70	2·63	2·57	2·51	2·45	2·40	2·35	2·30	2·25	2·21	2·17	2·13
α Ursæ Maj.	3·80	3·69	3·58	3·49	3·40	3·31	3·23	3·16	3·09	3·02	2·96	2·90	2·84	2·79	2·73	2·69
S. Decln.																
Rigel ..	·29	·28	·28	·27	·26	·25	·25	·24	·24	·23	·23	·22	·22	·21	·21	·21
Sirius ..	·60	·58	·56	·55	·53	·52	·51	·50	·48	·47	·46	·45	·45	·44	·43	·42
ε Sagittarii	1·37	1·33	1·29	1·26	1·23	1·19	1·17	1·14	1·11	1·09	1·07	1·04	1·02	1·00	·99	·97
λ Scorpii	1·51	1·47	1·42	1·39	1·35	1·32	1·28	1·25	1·23	1·20	1·17	1·15	1·13	1·11	1·09	1·07
γ Argûs ..	2·15	2·09	2·03	1·97	1·92	1·87	1·83	1·79	1·75	1·71	1·67	1·64	1·61	1·58	1·55	1·52
α Gruis ..	2·17	2·11	2·05	2·00	1·94	1·90	1·85	1·81	1·77	1·73	1·69	1·66	1·63	1·59	1 57	1·54
Canopus	2·62	2·54	2·47	2·41	2·34	2·28	2·23	2·18	2·13	2·08	2·04	2·00	1·96	1·92	1·89	1·85
γ Crucis ..	3·03	2·95	2·86	2·79	2·71	2·64	2·58	2·52	2·46	2·41	2·36	2·31	2·27	2·22	2·18	2·15
α Pavonis	3·08	2·99	2·91	2·83	2·76	2·69	2·62	2·56	2·50	2·45	2·40	2·35	2·30	2·26	2·22	2·18
Achernar	3·16	3·07	2·98	2·90	2·83	2·76	2·69	2·63	2·57	2·51	2·46	2·41	2·36	2·32	2·28	2·24
β Crucis / ε Argûs	3·36	3·26	3·17	3·08	3·00	2·93	2·85	2·79	2·73	2·67	2·61	2·56	2·51	2·46	2·42	2·37
β Centauri	3·46	3·35	3·26	3·17	3·09	3·01	2·94	2·87	2·81	2·74	2·69	2·63	2·58	2·53	2·49	2·44
α^2 Centauri	3·53	3·43	3·33	3·24	3·16	3·08	3·00	2·93	2·87	2·80	2·75	2·69	2·64	2·59	2·54	2·50
α^1 Crucis..	3·86	3·75	3·64	3·54	3·45	3·36	3·28	3·21	3·13	3·07	3·00	2·94	2·88	2·83	2·78	2·73
α Tri. Aus.	5·17	5·02	4·88	4·75	4·63	4·51	4·40	4·30	4·20	4·11	4·02	3·94	3·87	3·79	3·72	3·66
β Argûs ..	5·31	5·15	5·01	4·87	4·74	4·63	4·51	4·41	4·31	4·22	4·13	4·04	3·96	3·89	3·82	3·75
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	10 Hr.	9 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	3 HOURS.															4 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	·02	·02	·02	·02	·02	·01	·01	·01	·01	·01	·01	·01	·01	·01	·01	·01
2	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·02	·02	·02	·02	·02	·02
3	·05	·05	·05	·05	·05	·04	·04	·04	·04	·04	·04	·04	·03	·03	·03	·03
4	·07	·07	·07	·06	·06	·06	·06	·05	·05	·05	·05	·05	·05	·04	·04	·04
5	·09	·08	·08	·08	·08	·07	·07	·07	·07	·06	·06	·06	·06	·05	·05	·05
6	·11	·10	·10	·09	·09	·09	·09	·08	·08	·08	·07	·07	·07	·07	·06	·06
7	·12	·12	·11	·11	·11	·10	·10	·10	·09	·09	·09	·08	·08	·08	·07	·07
8	·14	·14	·13	·13	·12	·12	·11	·11	·11	·10	·10	·09	·09	·09	·08	·08
9	·16	·15	·15	·14	·14	·13	·13	·12	·12	·12	·11	·11	·10	·10	·10	·09
10	·18	·17	·16	·16	·15	·15	·14	·14	·13	·13	·12	·12	·11	·11	·11	·10
11	·19	·19	·18	·18	·17	·16	·16	·15	·15	·14	·14	·13	·13	·12	·12	·11
12	·21	·21	·20	·19	·18	·18	·17	·17	·16	·15	·15	·14	·14	·13	·13	·12
13	·23	·22	·22	·21	·20	·19	·19	·18	·17	·17	·16	·16	·15	·14	·14	·13
14	·25	·24	·23	·22	·22	·21	·20	·19	·19	·18	·17	·17	·16	·16	·15	·14
15	·27	·26	·25	·24	·23	·22	·22	·21	·20	·19	·19	·18	·17	·17	·16	·15
16	·29	·28	·27	·26	·25	·24	·23	·22	·22	·21	·20	·19	·19	18	·17	·17
17	·31	·30	·29	·28	·27	·26	25	·24	·23	·22	·21	·21	·20	·19	·18	·18
18	·32	·31	·30	·29	·28	·27	·26	·25	·24	·24	·23	·22	·21	·20	·20	·19
19	·34	·33	·32	·31	·30	·29	·28	·27	·26	·25	·24	·23	·22	·22	·21	·20
20	·36	·35	·34	·33	·32	·31	·29	·28	·27	·26	·25	·25	·24	·23	·22	·21
21	·38	·37	·36	·35	·33	·32	·31	·30	·29	·28	·27	·26	·25	·24	·23	·22
22	·40	·39	·38	·36	·35	·34	·33	·32	·30	·29	·28	·27	·26	·25	·24	·23
23	·42	·41	·40	·38	·37	·36	·34	·33	·32	·31	·30	·29	·28	·27	·25	·25
24	·45	·43	·42	·40	·39	·37	·36	·35	·34	·32	·31	·30	·29	·28	·27	·26
25	·47	·45	·43	·42	·41	·39	·38	·36	·35	·34	·33	·31	·30	·29	·28	·27
26	·49	·47	·45	·44	·42	·41	·39	·38	·37	·35	·34	·33	·32	·30	·29	·28
27	·51	·49	·48	·46	·44	·43	·41	·40	·38	·37	·36	·34	·33	·32	·31	·29
28	·53	·51	·50	·48	·46	·45	·43	·42	·40	·39	·37	·36	·35	·33	·32	·31
29	·55	·54	·52	·50	·48	·47	·45	·43	·42	·40	·39	·37	·36	·35	·33	·32
30	·58	·56	·54	·52	·50	·48	·47	·45	·44	·42	·40	·39	·37	·36	·35	·33
31	·60	·58	·56	·54	·52	·50	·49	·47	·45	·44	·42	·41	·39	·38	·36	·35
32	·62	·60	·58	·56	·54	·52	·51	·49	·47	·45	·44	·42	·41	·39	·38	·36
33	·65	·63	·61	·58	·56	·54	·53	·51	·49	·47	·45	·44	·42	·41	·39	·37
34	·67	·65	·63	·61	·59	·57	·55	·53	·51	·49	·47	·45	·44	·42	·41	·39
35	·70	·68	·65	·63	·61	·59	·57	·55	·53	·51	·49	·47	·45	·44	·42	·40
36	·73	·70	·68	·65	63	·61	·59	·57	·55	·53	·51	·49	·47	·45	·44	·42
37	·75	·73	·70	·68	66	·63	·61	·59	·57	·55	·53	·51	·49	·47	·45	·44
38	·78	·75	·73	·70	·68	·66	·63	·61	·59	·57	·55	·53	·51	·49	·47	·45
39	·81	·78	·75	·73	·70	·68	·66	·63	·61	·59	·57	·55	·53	·51	·49	·47
40	·84	·81	·78	·76	·73	·70	·68	·66	·63	·61	·59	·57	·54	·52	·50	·48
41	·87	·84	·81	·78	·76	·73	·70	·68	·65	·63	·61	·59	·56	·54	·52	·50
42	·90	·87	·84	·81	·78	·76	·73	·70	·68	·65	·63	·61	·58	·56	·54	·52
43	·93	·90	·87	·84	·81	·78	·76	·73	·70	·68	·65	·63	·61	·58	·56	·54
44	·97	·93	·90	·87	·84	·81	·78	·75	·73	·70	·68	·65	·63	·60	·58	·56
45	1·00	·97	·93	90	·87	·84	·81	·78	·75	·73	·70	·67	·65	·62	·60	·58
46	1·04	1·00	·97	·93	·90	·87	·84	·81	·78	·75	·73	·70	·67	·65	·62	·60
47	1·07	1·04	1 00	·97	·93	·90	·87	·84	·81	·78	·75	·72	·70	·67	·64	·62
48	1·11	1·07	1·04	1·00	·97	·93	90	·87	·84	·81	·78	·75	·72	·69	·67	·64
49	1·15	1·11	1·07	1·04	1·00	·97	·93	·90	·87	·84	·80	·78	·75	·72	·69	·66
50	1·19	1·15	1·11	1·07	1 04	1·00	·97	·93	·90	·87	·83	·80	·77	·74	·72	·69
51	1·23	1·19	1·15	1·11	1 07	1·04	1·00	·96	·93	·90	·86	·83	·80	·77	·74	·71
52	1·28	1·24	1·19	1·15	1·11	1·07	1 04	1·00	·96	·93	·90	·86	·83	·80	·77	·74
53	1·33	1·28	1·24	1·19	1·15	1·11	1·07	1 04	1·00	·96	·93	·90	·86	·83	·80	·77
54	1·38	1·33	1·28	1·24	1·20	1·15	1·11	1·08	1 04	1·00	·96	·93	·89	·86	·83	·79
55	1·43	1·38	1·33	1·29	1·24	1 20	1·16	1·12	1·08	1·04	1·00	·96	·93	·89	·86	·82
56	1·48	1·43	1·38	1·33	1 29	1·24	1·20	1·16	1·12	1·08	1·04	1·00	·96	·93	·89	·86
57	1·54	1·49	1·44	1·39	1·34	1·29	1·25	1·20	1·16	1·12	1·08	1·04	1·00	·96	·93	·89
58	1·60	1·55	1·49	1·44	1·39	1·34	1·30	1·25	1·21	1·16	1·12	1·08	1·04	1·00	·96	·92
59	1·66	1 61	1·55	1·50	1·45	1·40	1·35	1·30	1·25	1·21	1·17	1·12	1·08	1·04	1·00	·96
60	1·73	1·67	1·62	1·56	1·51	1·45	1·40	1·35	1·31	1·26	1·21	1·17	1·12	1·08	1·04	1·00
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	9 Hr.	8 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	8 HOURS.															4 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 18	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 58	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02
2	·05	·05	·05	·05	·05	·05	·04	·04	·04	·04	·04	·04	·04	·04	·04	·04
3	·07	·07	·07	·07	·07	·07	·07	·07	·07	·06	·06	·06	·06	·06	·06	·06
4	·10	·10	·10	·09	·09	·09	·09	·09	·09	·09	·09	·08	·08	·08	·08	·08
5	·12	·12	·12	·12	·12	·11	·11	·11	·11	·11	·11	·11	·10	·10	·10	·10
6	·15	·15	·14	·14	·14	·14	·14	·13	·13	·13	·13	·13	·13	·12	·12	·12
7	·17	·17	·17	·17	·16	·16	·16	·16	·15	·15	·15	·15	·15	·14	·14	·14
8	·20	·20	·19	·19	·19	·18	·18	·18	·18	·17	·17	·17	·17	·17	·16	·16
9	·22	·22	·22	·21	·21	·21	·20	·20	·20	·20	·19	·19	·19	·19	·18	·18
10	·25	·25	·24	·24	·23	·23	·23	·22	·22	·22	·22	·21	·21	·21	·21	·20
11	·27	·27	·27	·26	·26	·25	·25	·25	·24	·24	·24	·23	·23	·23	·23	·22
12	·30	·30	·29	·29	·28	·28	·27	·27	·27	·26	·26	·26	·25	·25	·25	·25
13	·33	·32	·32	·31	·31	·30	·30	·29	·29	·29	·28	·28	·28	·27	·27	·27
14	·35	·35	·34	·34	·33	·33	·32	·32	·31	·31	·30	·30	·30	·29	·29	·29
15	·38	·37	·37	·36	·36	·35	·34	·34	·34	·33	·33	·32	·32	·32	·31	·31
16	·41	·40	·39	·39	·38	·37	·37	·36	·36	·35	·35	·35	·34	·34	·33	·33
17	·43	·43	·42	·41	·41	·40	·39	·39	·38	·38	·37	·37	·36	·36	·36	·35
18	·46	·45	·44	·44	·43	·42	·42	·41	·41	·40	·40	·39	·39	·38	·38	·38
19	·49	·48	·47	·46	·46	·45	·44	·44	·43	·43	·42	·42	·41	·41	·40	·40
20	·51	·51	·50	·49	·48	·48	·47	·46	·46	·45	·44	·44	·43	·43	·42	·42
21	·54	·53	·52	·52	·51	·50	·49	·49	·48	·47	·47	·46	·46	·45	·45	·44
22	·57	·56	·55	·54	·54	·53	·52	·51	·51	·50	·49	·49	·48	·48	·47	·47
23	·60	·59	·58	·57	·56	·55	·55	·54	·53	·52	·52	·51	·51	·50	·50	·49
23° 28′	·61	·60	·59	·58	·58	·57	·56	·55	·54	·54	·53	·52	·52	·51	·51	·50
24	·63	·62	·61	·60	·59	·58	·57	·57	·56	·55	·54	·54	·53	·53	·52	·51
25	·66	·65	·64	·63	·62	·61	·60	·59	·58	·58	·57	·56	·56	·55	·54	·54
26	·69	·68	·67	·66	·65	·64	·63	·62	·61	·60	·60	·59	·58	·58	·57	·56
27	·72	·71	·70	·69	·68	·67	·66	·65	·64	·63	·62	·61	·61	·60	·59	·59
28	·75	·74	·73	·72	·70	·69	·68	·67	·67	·66	·65	·64	·63	·63	·62	·61
29	·78	·77	·76	·75	·73	·72	·71	·70	·69	·69	·68	·67	·66	·65	·65	·64
30	·82	·80	·79	·78	·76	·75	·74	·73	·72	·71	·70	·70	·69	·68	·67	·67
Stars.																
N. Decln.																
Procyon	·14	·13	·13	·13	·13	·12	·12	·12	·12	·12	·12	·12	·11	·11	·11	·11
Altair ..	·21	·21	·21	·20	·20	·20	·20	·19	·19	·19	·19	·18	·18	·18	·18	·18
Aldebar'n	·41	·41	·40	·39	·39	·38	·38	·37	·37	·36	·36	·35	·35	·35	·34	·34
Arcturus	·51	·50	·49	·48	·47	·47	·46	·45	·45	·44	·44	·43	·43	·42	·42	·41
Castor ..	·89	·87	·86	·84	·83	·82	·81	·80	·79	·77	·77	·76	·75	·74	·73	·72
Vega ..	1·13	1·11	1·10	1·08	1·06	1·05	1·03	1·02	1·00	·99	·98	·97	·96	·94	·93	·93
Deneb ..	1·41	1·39	1·37	1·34	1·32	1·30	1·28	1·27	1·25	1·23	1·22	1·20	1·19	1·18	1·16	1·15
Capella	1·46	1·43	1·41	1·39	1·37	1·35	1·33	1·31	1·29	1·28	1·26	1·25	1·23	1·22	1·20	1·19
α Persei ..	1·66	1·63	1·60	1·58	1·55	1·53	1·51	1·49	1·47	1·45	1·43	1·41	1·40	1·38	1·37	1·35
η Ursæ Maj.	1·67	1·64	1·62	1·59	1·57	1·54	1·52	1·50	1·48	1·46	1·44	1·43	1·41	1·39	1·38	1·36
ε Ursæ Maj.	2·13	2·10	2·06	2·03	2·00	1·97	1·94	1·91	1·89	1·86	1·84	1·82	1·80	1·78	1·76	1·74
α Ursæ Maj.	2·69	2·64	2·60	2·56	2·52	2·48	2·44	2·41	2·38	2·35	2·32	2·29	2·27	2·24	2·22	2·19
S. Decln.																
Rigel ..	·21	·20	·20	·20	·19	·19	·19	·19	·18	·18	·18	·18	·17	·17	·17	·17
Sirius ..	·42	·41	·41	·40	·39	·39	·38	·38	·37	·37	·36	·36	·36	·35	·35	·34
ε Sagittarii	·97	·95	·94	·92	·91	·89	·88	·87	·86	·85	·84	·83	·82	·81	·80	·79
λ Scorpii	1·07	1·05	1·03	1·02	1·00	·99	·97	·96	·94	·93	·92	·91	·90	·89	·88	·87
γ Argûs ..	1·52	1·49	1·47	1·45	1·42	1·40	1·38	1·36	1·35	1·33	1·31	1·30	1·28	1·27	1·25	1·24
α Gruis ..	1·54	1·51	1·49	1·46	1·44	1·42	1·40	1·38	1·36	1·34	1·33	1·31	1·30	1·28	1·27	1·26
Canopus	1·85	1·82	1·79	1·76	1·74	1·71	1·69	1·66	1·64	1·62	1·60	1·58	1·56	1·54	1·53	1·51
γ Crucis ..	2·15	2·11	2·07	2·04	2·01	1·98	1·95	1·93	1·90	1·88	1·85	1·83	1·81	1·79	1·77	1·75
α Pavonis	2·18	2·14	2·11	2·07	2·04	2·01	1·98	1·96	1·93	1·91	1·88	1·86	1·84	1·82	1·80	1·78
Achernar	2·24	2·20	2·16	2·13	2·10	2·06	2·03	2·01	1·98	1·95	1·93	1·91	1·89	1·86	1·84	1·83
β Crucis / ε Argûs	2·37	2·33	2·29	2·26	2·22	2·19	2·16	2·13	2·10	2·07	2·05	2·02	2·00	1·98	1·96	1·94
β Centauri	2·44	2·40	2·36	2·32	2·29	2·26	2·22	2·19	2·16	2·14	2·11	2·08	2·06	2·04	2·02	2·00
α^2 Centauri	2·50	2·45	2·41	2·37	2·34	2·30	2·27	2·24	2·21	2·18	2·15	2·13	2·10	2·08	2·06	2·04
α^1 Crucis..	2·73	2·68	2·64	2·60	2·56	2·52	2·48	2·45	2·42	2·38	2·36	2·33	2·30	2·27	2·25	2·23
α Tri. Aus.	3·66	3·60	3·54	3·48	3·43	3·38	3·33	3·28	3·24	3·20	3·16	3·12	3·08	3·05	3·02	2·99
β Argûs ..	3·75	3·69	3·63	3·57	3·52	3·46	3·41	3·37	3·32	3·28	3·24	3·20	3·16	3·13	3·10	3·06
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	9 Hr.	8 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	4 HOURS.																5 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 18	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00	
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
0	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	0
1	·010	·010	·009	·009	·009	·008	·008	·007	·007	·007	·006	·006	·006	·005	·005	·005	1
2	·020	·019	·019	·018	·017	·016	·016	·015	·014	·013	·013	·012	·011	·011	·010	·009	2
3	·030	·029	·028	·027	·026	·024	·023	·022	·021	·020	·019	·018	·017	·016	·015	·014	3
4	·040	·039	·037	·036	·034	·033	·031	·030	·028	·027	·025	·024	·023	·021	·020	·019	4
5	·051	·048	·047	·045	·043	·041	·039	·037	·035	·034	·032	·030	·028	·027	·025	·023	5
6	·061	·058	·056	·054	·051	·049	·047	·045	·042	·040	·038	·036	·034	·032	·030	·028	6
7	·071	·068	·065	·063	·060	·057	·055	·052	·050	·047	·045	·042	·040	·038	·035	·033	7
8	·081	·078	·075	·072	·069	·066	·063	·060	·057	·054	·051	·048	·046	·043	·040	·038	8
9	·091	·088	·084	·081	·077	·074	·071	·067	·064	·061	·058	·055	·051	·048	·045	·042	9
10	·102	·098	·094	·090	·086	·082	·079	·075	·071	·068	·064	·061	·057	·054	·051	·047	10
11	·112	·108	·103	·099	·095	·091	·087	·083	·079	·075	·071	·067	·063	·059	·056	·052	11
12	·123	·118	·113	·108	·104	·099	·095	·090	·086	·082	·077	·073	·069	·065	·061	·057	12
13	·133	·128	·123	·118	·113	·108	·103	·098	·093	·089	·084	·079	·075	·071	·066	·062	13
14	·144	·138	·133	·127	·122	·116	·111	·106	·101	·096	·091	·086	·081	·076	·071	·067	14
15	·155	·149	·142	·137	·131	·125	·119	·114	·108	·103	·098	·092	·087	·082	·077	·072	15
16	·166	·159	·152	·146	·140	·134	·128	·122	·116	·110	·104	·099	·093	·088	·082	·077	16
17	·177	·169	·163	·156	·149	·143	·136	·130	·124	·117	·111	·105	·099	·093	·088	·082	17
18	·188	·180	·173	·166	·158	·152	·145	·138	·131	·125	·118	·112	·106	·099	·093	·087	18
19	·199	·191	·183	·175	·168	·161	·153	·146	·139	·132	·125	·119	·112	·105	·099	·092	19
20	·210	·202	·194	·185	·178	·170	·162	·154	·147	·140	·132	·125	·118	·111	·104	·098	20
21	·222	·213	·204	·196	·187	·179	·171	·163	·155	·147	·140	·132	·125	·117	·110	·103	21
22	·233	·224	·215	·206	·197	·188	·180	·171	·163	·155	·147	·139	·131	·124	·116	·108	22
23	·245	·235	·226	·216	·207	·198	·189	·180	·171	·163	·154	·146	·138	·130	·122	·114	23
24	·257	·247	·237	·227	·217	·208	·198	·189	·180	·171	·162	·153	·145	·136	·128	·119	24
25	·269	·258	·248	·238	·227	·217	·208	·198	·188	·179	·170	·161	·152	·143	·134	·125	25
26	·282	·270	·259	·249	·238	·227	·217	·207	·197	·187	·178	·168	·158	·149	·140	·131	26
27	·294	·282	·271	·260	·249	·238	·227	·216	·206	·196	·185	·175	·166	·156	·146	·137	27
28	·307	·295	·283	·271	·259	·248	·237	·226	·215	·204	·194	·183	·173	·163	·152	·142	28
29	·320	·307	·295	·282	·270	·258	·247	·235	·224	·213	·202	·191	·180	·169	·159	·149	29
30	·333	·320	·307	·294	·282	·269	·257	·245	·233	·222	·210	·199	·188	·177	·166	·155	30
31	·347	·333	·319	·306	·293	·280	·268	·255	·243	·231	·219	·207	·195	·184	·172	·161	31
32	·361	·346	·332	·318	·305	·291	·278	·265	·252	·240	·227	·215	·203	·191	·179	·167	32
33	·375	·360	·345	·331	·317	·303	·289	·276	·262	·249	·236	·224	·211	·199	·186	·174	33
34	·389	·374	·359	·344	·329	·315	·300	·286	·273	·259	·246	·232	·219	·206	·193	·181	34
35	·404	·388	·372	·357	·342	·327	·312	·297	·283	·269	·255	·241	·228	·214	·201	·188	35
36	·419	·403	·386	·370	·354	·339	·323	·308	·294	·279	·264	·250	·236	·222	·208	·195	36
37	·435	·418	·401	·384	·368	·351	·336	·320	·304	·289	·274	·259	·245	·230	·216	·202	37
38	·451	·433	·415	·398	·381	·364	·348	·332	·316	·300	·284	·269	·254	·239	·224	·209	38
39	·468	·449	·431	·413	·395	·378	·361	·344	·327	·311	·295	·279	·263	·248	·232	·217	39
40	·484	·465	·446	·428	·409	·391	·374	·356	·339	·322	·305	·289	·273	·257	·241	·225	40
41	·502	·482	·462	·443	·424	·405	·387	·369	·351	·334	·316	·299	·282	·266	·249	·233	41
42	·520	·499	·479	·459	·439	·420	·401	·382	·364	·346	·328	·310	·293	·275	·258	·241	42
43	·538	·517	·496	·475	·455	·435	·415	·396	·377	·358	·339	·321	·303	·285	·267	·250	43
44	·558	·535	·513	·492	·471	·450	·430	·410	·390	·371	·351	·333	·314	·295	·277	·259	44
45	·577	·554	·532	·510	·488	·466	·445	·424	·404	·384	·364	·344	·325	·306	·287	·268	45
46	·598	·574	·551	·528	·505	·483	·461	·440	·418	·398	·377	·357	·336	·317	·297	·277	46
47	·619	·594	·570	·546	·523	·500	·477	·455	·433	·412	·390	·369	·348	·328	·307	·287	47
48	·641	·616	·591	·566	·542	·518	·494	·471	·449	·426	·404	·382	·361	·340	·318	·298	48
49	·664	·638	·612	·586	·561	·536	·512	·488	·465	·442	·419	·396	·374	·352	·330	·308	49
50	·688	·661	·634	·607	·581	·556	·531	·506	·481	·457	·434	·410	·387	·364	·342	·319	50
51	·713	·685	·657	·629	·602	·576	·550	·524	·499	·474	·449	·425	·401	·378	·354	·331	51
52	·739	·709	·681	·652	·624	·597	·570	·543	·517	·491	·466	·441	·416	·391	·367	·343	52
53	·766	·736	·706	·676	·647	·619	·591	·563	·536	·509	·483	·457	·431	·406	·381	·356	53
54	·795	·763	·732	·701	·671	·642	·613	·584	·556	·528	·501	·474	·447	·421	·395	·369	54
55	·825	·792	·759	·728	·697	·666	·636	·606	·577	·548	·520	·492	·464	·437	·410	·383	55
56	·856	·822	·788	·755	·723	·691	·660	·629	·599	·569	·540	·510	·482	·453	·425	·397	56
57	·889	·854	·819	·785	·751	·718	·686	·654	·622	·591	·560	·530	·500	·471	·442	·413	57
58	·924	·887	·851	·815	·781	·746	·713	·679	·647	·614	·582	·551	·520	·489	·459	·429	58
59	·961	·923	·885	·848	·812	·776	·741	·706	·672	·639	·606	·573	·541	·509	·477	·446	59
60	1·000	·960	·921	·883	·845	·808	·771	·735	·700	·665	·630	·596	·563	·530	·497	·464	60
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0	
	8 Hr.	7 HOURS.															

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	4 HOURS.															5 Hr.
	m. 00	m. 4	m. 6	m. 12	m. 16	m. 20	m. 24	m. 26	m. 32	m. 36	m. 40	m. 44	m. 46	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000
1	·020	·020	·020	·020	·019	·019	·019	·019	·019	·019	·019	·018	·018	·018	·018	·018
2	·040	·040	·040	·039	·039	·039	·038	·038	·038	·037	·037	·037	·037	·037	·036	·036
3	·061	·060	·059	·059	·058	·058	·057	·057	·057	·056	·056	·055	·055	·055	·055	·054
4	·081	·080	·079	·078	·078	·077	·077	·076	·075	·075	·074	·074	·074	·073	·073	·072
5	·101	·100	·099	·098	·097	·097	·096	·095	·094	·094	·093	·093	·092	·091	·091	·091
6	·121	·120	·119	·118	·117	·116	·115	·114	·113	·113	·112	·111	·111	·110	·109	·109
7	·142	·140	·139	·138	·137	·135	·134	·133	·132	·132	·131	·130	·129	·128	·128	·127
8	·162	·161	·159	·158	·156	·155	·154	·153	·152	·151	·150	·149	·148	·147	·146	·145
9	·183	·181	·179	·178	·176	·175	·173	·172	·171	·170	·169	·168	·167	·166	·165	·164
10	·204	·202	·200	·198	·196	·195	·193	·192	·190	·189	·188	·186	·185	·184	·183	·183
11	·224	·222	·220	·218	·216	·214	·213	·211	·210	·208	·207	·206	·204	·203	·202	·201
12	·245	·243	·241	·239	·236	·235	·233	·231	·229	·228	·226	·225	·223	·222	·221	·220
13	·267	·264	·261	·259	·257	·255	·253	·251	·249	·247	·246	·244	·243	·241	·240	·239
14	·288	·285	·282	·280	·277	·275	·273	·271	·269	·267	·265	·264	·262	·261	·259	·258
15	·309	·306	·303	·301	·298	·296	·293	·291	·289	·287	·285	·283	·282	·280	·279	·277
16	·331	·328	·325	·322	·319	·316	·314	·312	·309	·307	·305	·303	·302	·300	·298	·297
17	·353	·350	·346	·343	·340	·337	·335	·332	·330	·327	·325	·323	·321	·320	·318	·317
18	·375	·371	·368	·365	·362	·359	·356	·353	·350	·348	·346	·344	·342	·340	·338	·336
19	·398	·394	·390	·386	·383	·380	·377	·374	·371	·369	·366	·364	·362	·360	·358	·356
20	·420	·416	·412	·408	·405	·402	·398	·395	·393	·390	·387	·385	·383	·381	·379	·377
21	·443	·439	·435	·431	·427	·424	·420	·417	·414	·411	·408	·406	·404	·401	·399	·397
22	·467	·462	·458	·453	·450	·446	·442	·439	·436	·433	·430	·427	·425	·422	·420	·418
23	·490	·485	·481	·476	·472	·468	·465	·461	·458	·455	·452	·449	·446	·444	·442	·439
23° 28′	·501	·496	·492	·487	·483	·479	·475	·472	·468	·465	·462	·459	·456	·454	·452	·449
24	·514	·509	·504	·500	·495	·491	·487	·484	·480	·477	·474	·471	·468	·466	·463	·461
25	·538	·533	·528	·523	·519	·515	·510	·507	·503	·499	·496	·493	·490	·488	·485	·483
26	·563	·558	·552	·547	·543	·538	·534	·530	·526	·522	·519	·516	·513	·510	·507	·505
27	·588	·583	·577	·572	·567	·562	·558	·554	·550	·546	·542	·539	·536	·533	·530	·527
28	·614	·608	·602	·597	·592	·587	·582	·578	·573	·570	·566	·562	·559	·556	·553	·550
29	·640	·634	·628	·622	·617	·612	·607	·602	·598	·594	·590	·586	·583	·580	·577	·574
30	·667	·660	·654	·648	·642	·637	·632	·627	·623	·618	·614	·611	·607	·604	·601	·598
Stars.																
N. Decln.																
Procyon	·110	·109	·108	·107	·106	·105	·105	·104	·103	·102	·102	·101	·100	·100	·099	·099
Altair ..	·175	·174	·172	·170	·169	·167	·166	·165	·164	·163	·161	·160	·160	·159	·158	·157
Aldebar'n	·338	·335	·332	·329	·326	·323	·321	·318	·316	·314	·312	·310	·308	·306	·305	·303
Arcturus	·412	·408	·405	·401	·397	·394	·391	·388	·385	·383	·380	·378	·376	·373	·372	·370
Castor ..	·724	·717	·710	·704	·698	·692	·686	·681	·676	·672	·667	·663	·659	·656	·652	·649
Vega ..	·925	·916	·907	·899	·891	·884	·877	·870	·864	·858	·852	·847	·842	·838	·833	·829
Deneb ..	1·15	1·14	1·13	1·12	1·11	1·10	1·09	1·08	1·08	1·07	1·06	1·06	1·05	1·04	1·04	1·03
Capella	1·19	1·18	1·17	1·16	1·15	1·14	1·13	1·12	1·11	1·11	1·10	1·09	1·09	1·08	1·07	1·07
α Persei ..	1·35	1·34	1·33	1·32	1·30	1·29	1·28	1·27	1·26	1·26	1·25	1·24	1·23	1·23	1·22	1·21
η Ursæ Maj	1·36	1·35	1·34	1·33	1·31	1·30	1·29	1·28	1·27	1·27	1·26	1·25	1·24	1·24	1·23	1·22
ε Ursæ Maj.	1·74	1·72	1·71	1·69	1·68	1·66	1·65	1·64	1·63	1·62	1·60	1·59	1·59	1·58	1·57	1·56
α Ursæ Maj	2·19	2·17	2·15	2·13	2·11	2·10	2·08	2·06	2·05	2·03	2·02	2·01	2·00	1·99	1·98	1·97
S. Decln.																
Rigel ..	·169	·167	·165	·164	·162	·161	·160	·159	·157	·156	·155	·154	·153	·153	·152	·151
Sirius ..	·344	·341	·337	·334	·332	·329	·326	·324	·321	·319	·317	·315	·313	·311	·310	·308
ε Sagittarii	·791	·784	·776	·769	·763	·756	·750	·745	·739	·734	·729	·725	·721	·717	·713	·710
λ Scorpii	·871	·863	·855	·847	·840	·833	·826	·820	·814	·808	·803	·798	·793	·789	·785	·781
γ Argûs	1·24	1·23	1·22	1·21	1·20	1·19	1·18	1·17	1·16	1·15	1·14	1·14	1·13	1·12	1·12	1·11
α Gruis	1·26	1·24	1·23	1·22	1·21	1·20	1·19	1·18	1·17	1·16	1·16	1·15	1·14	1·14	1·13	1·13
Canopus	1·51	1·50	1·48	1·47	1·46	1·45	1·43	1·42	1·41	1·40	1·39	1·39	1·38	1·37	1·36	1·36
γ Crucis ..	1·75	1·73	1·72	1·70	1·69	1·67	1·66	1·65	1·64	1·63	1·61	1·60	1·60	1·59	1·58	1·57
α Pavonis	1·78	1·76	1·75	1·73	1·71	1·70	1·69	1·67	1·66	1·65	1·64	1·63	1·62	1·61	1·60	1·60
Achernar	1·83	1·81	1·79	1·77	1·76	1·74	1·73	1·72	1·71	1·69	1·68	1·67	1·66	1·65	1·65	1·64
β Crucis) ε Argûs)	1·94	1·92	1·90	1·88	1·87	1·85	1·84	1·82	1·81	1·80	1·79	1·77	1·76	1·75	1·75	1·74
β Centauri	2·00	1·98	1·96	1·94	1·92	1·91	1·89	1·88	1·86	1·85	1·84	1·83	1·82	1·81	1·80	1·79
α^2 Centauri	2·04	2·02	2·00	1·98	1·96	1·95	1·93	1·92	1·90	1·89	1·88	1·87	1·86	1·85	1·84	1·83
α^1 Crucis ..	2·23	2·21	2·18	2·17	2·15	2·13	2·11	2·10	2·08	2·07	2·05	2·04	2·03	2·02	2·01	2·00
α Tri. Aus.	2·99	2·96	2·93	2·90	2·88	2·85	2·83	2·81	2·79	2·77	2·75	2·74	2·72	2·70	2·69	2·68
β Argûs ..	3·06	3·03	3·00	2·98	2·95	2·93	2·90	2·88	2·86	2·84	2·82	2·81	2·79	2·77	2·76	2·75
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	8 Hr.	7 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat	5 HOURS.															6 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000
1	·005	·004	·004	·004	·003	·003	·003	·002	·002	·002	·002	·001	·001	·001	·000	·000
2	·009	·009	·008	·007	·007	·006	·006	·005	·004	·004	·003	·002	·002	·001	·001	·000
3	·014	·013	·012	·011	·010	·009	·008	·007	·006	·006	·005	·004	·003	·002	·001	·000
4	·019	·017	·016	·015	·014	·012	·011	·010	·009	·007	·006	·005	·004	·002	·001	·000
5	·023	·022	·020	·019	·017	·015	·014	·012	·011	·009	·008	·006	·005	·003	·002	·000
6	·028	·026	·024	·022	·020	·019	·017	·015	·013	·011	·009	·007	·006	·004	·002	·000
7	·033	·031	·028	·026	·024	·022	·019	·017	·015	·013	·011	·009	·006	·004	·002	·000
8	·038	·035	·032	·030	·027	·025	·022	·020	·017	·015	·012	·010	·007	·005	·003	·000
9	·042	·039	·037	·034	·031	·028	·025	·022	·019	·017	·014	·011	·008	·006	·003	·000
10	·047	·044	·041	·037	·034	·031	·028	·025	·022	·019	·015	·012	·009	·006	·003	·000
11	·052	·048	·045	·041	·038	·034	·031	·027	·024	·020	·017	·014	·010	·007	·003	·000
12	·057	·053	·049	·045	·041	·037	·034	·030	·026	·022	·019	·015	·011	·007	·004	·000
13	·062	·058	·053	·049	·045	·041	·037	·032	·028	·024	·020	·016	·012	·008	·004	·000
14	·067	·062	·058	·053	·048	·044	·039	·035	·031	·026	·022	017	·013	·009	·004	·000
15	·072	·067	·062	·057	·052	·047	·042	·038	·033	·028	·023	·019	·014	·009	·005	·000
16	·077	·071	·066	·061	·056	·051	·045	·040	·035	·030	·025	·020	·015	·010	·005	·000
17	·082	·076	·071	·065	·059	·054	·048	·043	·038	·032	·027	·021	·016	·011	·005	·000
18	·087	·081	·075	·069	·063	·057	·051	·046	·040	·034	·028	·023	·017	·011	·006	·000
19	·092	·086	·079	·073	·067	·061	·055	·048	·042	·036	·030	·024	·018	·012	·006	·000
20	·098	·091	·084	·077	·071	·064	·058	·051	·045	·038	·032	·025	·019	·013	·006	·000
21	·103	·096	·089	·082	·075	·068	·061	·054	·047	·040	·034	·027	·020	·013	·007	·000
22	·108	·101	·093	·086	·079	·071	·064	·057	·050	·042	·035	·028	·021	·014	·007	·000
23	·114	·106	·098	·090	·083	·075	·067	·060	·052	·045	·037	·030	·022	·015	·007	·000
24	·119	·111	·103	·095	·087	·079	·071	·063	·055	·047	·039	·031	·023	·016	·008	·000
25	·125	·116	·108	·099	·091	·082	·074	·066	·057	·049	·041	·033	·024	·016	·008	·000
26	·131	·122	·113	·104	·095	·086	·077	·069	·060	·051	·043	·034	·026	·017	·009	·000
27	·137	·127	·118	·108	·099	·090	·081	·072	·063	·054	·045	·036	·027	·018	·009	·000
28	·142	·133	·123	·113	·103	·094	·084	·075	·065	·056	·047	·037	·028	·019	·009	·000
29	·149	·138	·128	·118	·108	·098	·088	·078	·068	·058	·048	·039	·029	·019	·010	·000
30	·155	·144	·133	·123	·112	·102	·091	·081	·071	·061	·051	·040	·030	·020	·010	·000
31	·161	·150	·139	·128	·117	·106	·095	·084	·074	·063	·053	·042	·031	·021	·010	·000
32	·167	·156	·144	·133	·121	·110	·099	·088	·077	·066	·055	·044	·033	·022	·011	·000
33	·174	·162	·150	·138	·126	·115	·103	·091	·080	·068	·057	·045	·034	·023	·011	·000
34	·181	·168	·156	·143	·131	·119	·107	·095	·083	·071	·059	·047	·035	·024	·012	·000
35	·188	·175	·162	·149	·136	·123	·111	·098	·086	·074	·061	·049	·037	·024	·012	·000
36	·195	·181	·168	·154	·141	·128	·115	·102	·089	·076	·064	·051	·038	·025	·013	·000
37	·202	·188	·174	·160	·146	·133	·119	·106	·093	·079	·066	·053	·039	·026	·013	·000
38	·209	·195	·180	·166	·152	·138	·124	·110	·096	·082	·068	·055	·041	·027	·014	·000
39	·217	·202	·187	·172	·157	·143	·128	·114	·099	·085	·071	·057	·042	·028	·014	·000
40	·225	·209	·194	·178	·163	·148	·133	·118	·103	·088	·073	·059	·044	·029	·015	·000
41	·233	·217	·201	·185	·169	·153	·138	·122	·107	·091	·076	·061	·046	·030	·015	·000
42	·241	·224	·208	·191	·175	·159	·143	·127	·111	·095	·079	·063	·047	·031	·016	·000
43	·250	·233	·215	·198	·181	·164	·148	·131	·114	·098	·082	·065	·049	·033	·016	·000
44	·259	·241	·223	·205	·188	·170	·153	·136	·119	·101	·084	·068	·051	·034	·017	·000
45	·268	·249	·231	·213	·194	·176	·158	·141	·123	·105	·087	·070	·052	·035	·017	·000
46	·277	·258	·239	·220	·201	·183	·164	·146	·127	·109	·091	·072	·054	·036	·018	·000
47	·287	·267	·248	·228	·208	·189	·170	·151	·132	·113	·094	·075	·056	·037	·019	·000
48	·298	·277	·256	·236	·216	·196	·176	·156	·136	·117	·097	·078	·058	·039	·019	·000
49	·308	·287	·266	·245	·224	·203	·182	·162	·141	·121	·101	·080	·060	·040	·020	·000
50	·319	·297	·275	·253	·232	·210	·189	·167	·146	·125	·104	·083	·062	·042	·021	·000
51	·331	·308	·285	·262	·240	·218	·196	·174	·152	·130	·108	·086	065	·043	·022	·000
52	·343	·319	·295	·272	·249	·226	·203	·180	·157	·135	·112	·090	·067	·045	·022	·000
53	·356	·331	·306	·282	·258	·234	·210	·187	·163	·139	·116	·093	·070	·046	·023	·000
54	·369	·343	·318	·293	·268	·243	·218	·193	·169	·145	·120	·096	·072	·048	·024	·000
55	·383	·356	·330	·304	·278	·252	·226	·201	·175	·150	·125	·100	·075	·050	·025	·000
56	·397	·370	·342	·315	·288	·261	·235	·208	·182	·156	·130	·104	·078	·052	·026	·000
57	·413	·384	·356	·327	·299	·272	·244	·216	·189	·162	·135	·108	·081	·054	·027	·000
58	·429	·399	·369	·340	·311	·282	·253	·225	·196	·168	·140	·112	·084	·056	·028	·000
59	·446	·415	·384	·354	·324	·293	·264	·234	·204	·175	·146	·116	·087	·058	·029	·000
60	·464	·432	·400	·368	·337	·305	·274	·243	·213	·182	·152	·121	·091	·060	·030	·000
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	7 Hr.	6 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	5 HOURS.															6 Hr.
	m. 00	m. 4	m. 6	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 46	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000
1	·018	·018	·018	·018	·018	·018	·018	·018	·018	·018	·018	·017	·017	·017	·017	·017
2	·036	·036	·036	·036	·036	·035	·035	·035	·035	·035	·035	·035	·035	·035	·035	·035
3	·054	·054	·054	·054	·053	·053	·053	·053	·053	·053	·053	·053	·052	·052	·052	·052
4	·072	·072	·072	·071	·071	·071	·071	·071	·070	·070	·070	·070	·070	·070	·070	·070
5	·091	·090	·090	·089	·089	·089	·089	·088	·088	·088	·088	·088	·088	·088	·088	·087
6	·109	·108	·108	·107	·107	·107	·106	·106	·106	·106	·106	·105	·105	·105	·105	·105
7	·127	·127	·126	·126	·125	·125	·124	·124	·124	·123	·123	·123	·123	·123	·123	·123
8	·145	·145	·144	·144	·143	·143	·142	·142	·142	·141	·141	·141	·141	·141	·141	·141
9	·164	·163	·163	·162	·161	·161	·160	·160	·160	·159	·159	·159	·159	·158	·158	·158
10	·183	·182	·181	·180	·180	·179	·179	·178	·178	·177	·177	·177	·177	·176	·176	·176
11	·201	·200	·199	·199	·198	·197	·197	·196	·196	·195	·195	·195	·195	·194	·194	·194
12	·220	·219	·218	·217	·217	·216	·215	·215	·214	·214	·213	·213	·213	·213	·213	·213
13	·239	·238	·237	·236	·235	·234	·234	·233	·233	·232	·232	·231	·231	·231	·231	·231
14	·258	·257	·256	·255	·254	·253	·252	·252	·251	·251	·250	·250	·250	·249	·249	·249
15	·277	·276	·275	·274	·273	·272	·271	·271	·270	·269	·269	·269	·268	·268	·268	·268
16	·297	·296	·294	·293	·292	·291	·290	·290	·289	·288	·288	·287	·287	·287	·287	·287
17	·317	·315	·314	·313	·311	·310	·310	·309	·308	·307	·307	·306	·306	·306	·306	·306
18	·336	·335	·333	·332	·331	·330	·329	·328	·327	·327	·326	·326	·325	·325	·325	·325
19	·356	·355	·353	·352	·351	·350	·349	·348	·347	·346	·346	·345	·345	·345	·344	·344
20	·377	·375	·374	·372	·371	·370	·369	·368	·367	·366	·365	·365	·364	·364	·364	·364
21	·397	·396	·394	·392	·391	·390	·389	·388	·387	·386	·385	·385	·384	·384	·384	·384
22	·418	·416	·415	·413	·412	·410	·409	·408	·407	·406	·406	·405	·405	·404	·404	·404
23	·439	·437	·436	·434	·432	·431	·430	·429	·428	·427	·426	·426	·425	·425	·425	·424
23° 28′	·449	·447	·446	·444	·442	·441	·440	·438	·437	·437	·436	·435	·435	·434	·434	·434
24	·461	·459	·457	·455	·454	·452	·451	·450	·449	·448	·447	·446	·446	·445	·445	·445
25	·483	·481	·479	·477	·475	·474	·472	·471	·470	·469	·468	·467	·467	·467	·466	·466
26	·505	·503	·501	·499	·497	·495	·494	·493	·491	·490	·490	·489	·488	·488	·488	·488
27	·527	·525	·523	·521	·519	·517	·516	·515	·513	·512	·511	·511	·510	·510	·510	·510
28	·550	·548	·546	·544	·542	·540	·538	·537	·536	·535	·534	·533	·532	·532	·532	·532
29	·574	·571	·569	·567	·565	·563	·561	·560	·558	·557	·556	·556	·555	·555	·554	·554
30	·598	·595	·593	·590	·588	·586	·585	·583	·582	·581	·580	·579	·578	·578	·577	·577
Stars.																
N. Decln.																
Procyon	·099	·098	·098	·098	·097	·097	·097	·096	·096	·096	·096	·096	·096	·096	·096	·096
Altair ..	·157	·156	·156	·155	·155	·154	·154	·153	·153	·153	·152	·152	·152	·152	·152	·152
Aldebar'n	·303	·302	·301	·300	·298	·297	·297	·296	·295	·295	·294	·294	·293	·293	·293	·293
Arcturus	·370	·368	·367	·365	·364	·363	·362	·361	·360	·359	·359	·358	·358	·357	·357	·357
Castor ..	·649	·646	·643	·641	·639	·637	·635	·633	·632	·630	·629	·628	·628	·627	·627	·627
Vega ..	·829	·826	·822	·819	·816	·813	·811	·809	·807	·806	·804	·803	·802	·802	·801	·801
Deneb ..	1·03	1·03	1·02	1·02	1·02	1·01	1·01	1·01	1·01	1·00	1·00	1·00	1·00	1·00	1·00	1·00
Capella	1·07	1·06	1·06	1·06	1·05	1·05	1·05	1·04	1·04	1·04	1·04	1·03	1·03	1·03	1·03	1·03
α Persei ..	1·21	1·21	1·20	1·20	1·19	1·19	1·19	1·18	1·18	1·18	1·18	1·17	1·17	1·17	1·17	1·17
η Ursæ Maj	1·22	1·22	1·21	1·21	1·20	1·20	1·20	1·19	1·19	1·19	1·19	1·18	1·18	1·18	1·18	1·18
ε Ursæ Maj	1·56	1·55	1·55	1·54	1·54	1·53	1·53	1·52	1·52	1·52	1·51	1·51	1·51	1·51	1·51	1·51
α Ursæ Maj	1·97	1·96	1·95	1·94	1·94	1·93	1·92	1·92	1·91	1·91	1·91	1·90	1·90	1·90	1·90	1·90
S. Decln.																
Rigel ..	·151	·150	·150	·149	·149	·148	·148	·147	·147	·147	·147	·146	·146	·146	·146	·146
Sirius ..	·308	·307	·306	·305	·303	·303	·302	·301	·300	·300	·299	·299	·298	·298	·298	·298
ε Sagittarii	·710	·706	·703	·701	·698	·696	·694	·692	·691	·689	·688	·687	·686	·686	·686	·685
λ Scorpii	·781	·778	·774	·771	·769	·766	·764	·762	·760	·759	·757	·756	·756	·755	·755	·755
γ Argûs	1·11	1·11	1·10	1·10	1·10	1·09	1·09	1·09	1·08	1·08	1·08	1·08	1·08	1·08	1·08	1·08
α Gruis	1·13	1·12	1·12	1·11	1·11	1·10	1·10	1·10	1·10	1·09	1·09	1·09	1·09	1·09	1·09	1·09
Canopus	1·36	1·35	1·34	1·34	1·33	1·33	1·33	1·32	1·32	1·32	1·32	1·31	1·31	1·31	1·31	1·31
γ Crucis ..	1·57	1·56	1·56	1·55	1·55	1·54	1·54	1·53	1·53	1·53	1·52	1·52	1·52	1·52	1·52	1·52
α Pavonis	1·60	1·59	1·58	1·58	1·57	1·57	1·56	1·56	1·55	1·55	1·55	1·55	1·54	1·54	1·54	1·54
Achernar	1·64	1·63	1·62	1·62	1·61	1·61	1·60	1·60	1·59	1·59	1·59	1·59	1·58	1·58	1·58	1·58
β Crucis, ε Argûs	1·74	1·73	1·72	1·72	1·71	1·70	1·70	1·69	1·69	1·69	1·68	1·68	1·68	1·68	1·68	1·68
β Centauri	1·79	1·78	1·77	1·77	1·76	1·75	1·75	1·74	1·74	1·74	1·73	1·73	1·73	1·73	1·73	1·73
α^2 Centauri	1·83	1·82	1·81	1·80	1·80	1·79	1·79	1·78	1·78	1·77	1·77	1·77	1·77	1·77	1·77	1·76
α^1 Crucis ..	2·00	1·99	1·98	1·97	1·97	1·96	1·95	1·95	1·94	1·94	1·94	1·93	1·93	1·93	1·93	1·93
α Tri. Aus.	2·68	2·67	2·65	2·64	2·64	2·63	2·62	2·61	2·61	2·60	2·60	2·59	2·59	2·59	2·59	2·59
β Argûs ..	2·75	2·73	2·72	2·71	2·70	2·69	2·69	2·68	2·67	2·67	2·66	2·66	2·66	2·65	2·65	2·65
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	7 Hr.	6 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	0 HOUR.																1 Hr.
	m. 1	Var. to 1′ of L.	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 26	m. 32	m. 38	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	″	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	413	17·0	103	52	34	26	21	17·2	14·7	12·8	11·4	10·2	9·3	8·5	7·8	7·2	6·7
62	431	18·2	108	54	36	27	21	17·9	15·3	13·4	11·9	10·7	9·7	8·8	8·1	7·5	7·0
63	450	19·4	112	56	37	28	22	18·7	16·0	14·0	12·4	11·1	10·1	9·2	8·5	7·9	7·3
64	470	20·8	117	59	39	29	23	19·5	16·7	14·7	12·9	11·6	10·5	9·6	8·9	8·2	7·7
65	491	22·4	123	61	41	31	25	20·4	17·5	15·3	13·5	12·2	11·0	10·1	9·3	8·6	8·0
66	515	24·2	129	64	43	32	26	21·4	18·3	16·0	14·2	12·7	11·6	10·6	9·7	9·0	8·4
67	540	26·2	135	67	45	34	27	22·4	19·2	16·8	14·9	13·4	12·1	11·1	10·2	9·4	8·8
68	567	28·6	142	71	47	35	28	23·5	20·2	17·6	15·6	14·0	12·7	11·6	10·7	9·9	9·2
69	597	31·2	149	75	50	37	30	24·8	21·2	18·5	16·4	14·8	13·4	12·3	11·3	10·4	9·7
70	630	34·3	157	79	52	39	31	26·1	22·4	19·5	17·3	15·6	14·1	12·9	11·9	11·0	10·3
71	666	37·8	166	83	55	42	33	27·6	23·7	20·7	18·3	16·5	14·9	13·7	12·6	11·6	10·8
72	705	42·0	176	88	59	44	35	29·3	25·1	21·9	19·4	17·5	15·8	14·6	13·3	12·3	11·5
	m.		m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
	59	..	56	52	48	44	40	36	32	28	24	20	16	12	8	4	00
	11 HOURS.																

Lat.	1 HOUR.															2 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 18	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	6·7	6·3	5·9	5·55	5·24	4·96	4·70	4·47	4·25	4·05	3·87	3·70	3·54	3·39	3·25	3·12
62	7·0	6·6	6·2	5·79	5·46	5·17	4·90	4·65	4·43	4·22	4·03	3·86	3·69	3·54	3·39	3·26
63	7·3	6·8	6·4	6·04	5·70	5·39	5·11	4·86	4·62	4·41	4·21	4·02	3·85	3·69	3·54	3·40
64	7·7	7·2	6·7	6·31	5·95	5·63	5·34	5·07	4·83	4·61	4·40	4·20	4·02	3·86	3·70	3·55
65	8·0	7·5	7·0	6·60	6·23	5·89	5·59	5·31	5·05	4·82	4·60	4·40	4·21	4·03	3·87	3·71
66	8·4	7·8	7·3	6·91	6·52	6·17	5·85	5·56	5·29	5·04	4·82	4·61	4·41	4·22	4·05	3·89
67	8·8	8·2	7·7	7·25	6·84	6·47	6·14	5·83	5·55	5·29	5·05	4·83	4·62	4·43	4·25	4·08
68	9·2	8·6	8·1	7·62	7·19	6·80	6·45	6·13	5·83	5·56	5·31	5·07	4·86	4·65	4·47	4·29
69	9·7	9·1	8·5	8·02	7·57	7·16	6·79	6·45	6·14	5·85	5·59	5·34	5·11	4·90	4·70	4·51
70	10·3	9·6	9·0	8·46	7·98	7·55	7·16	6·80	6·47	6·17	5·89	5·63	5·39	5·17	4·96	4·76
71	10·8	10·1	9·5	8·94	8·43	7·98	7·57	7·19	6·84	6·52	6·23	5·95	5·70	5·46	5·24	5·03
72	11·5	10·7	10·1	9·47	8·94	8·46	8·02	7·62	7·25	6·91	6·60	6·31	6·04	5·79	5·55	5·33
	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
	00	56	52	48	44	40	36	32	28	24	20	16	12	8	4	00
	11 Hr.	10 HOURS.														

Lat.	2 HOURS.															3 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 26	m. 32	m 36	m. 40	m. 44	m. 46	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	3·12	3·00	2·89	2·78	2·67	2·58	2·48	2·39	2·31	2·23	2·15	2·08	2·00	1·93	1·87	1·80
62	3·26	3·13	3·01	2·90	2·79	2·69	2·59	2·50	2·41	2·32	2·24	2·16	2·09	2·02	1·95	1·88
63	3·40	3·27	3·14	3·02	2·91	2·80	2·70	2·60	2·51	2·42	2·34	2·26	2·18	2·10	2·03	1·96
64	3·55	3·41	3·28	3·16	3·04	2·93	2·82	2·72	2·62	2·53	2·44	2·36	2·28	2·20	2·12	2·05
65	3·71	3·57	3·43	3·30	3·18	3·06	2·95	2·85	2·74	2·65	2·56	2·47	2·38	2·30	2·22	2·14
66	3·89	3·74	3·59	3·46	3·33	3·21	3·09	2·98	2·87	2·77	2·68	2·58	2·49	2·41	2·33	2·25
67	4·08	3·92	3·77	3·63	3·49	3·36	3·24	3·13	3·02	2·91	2·81	2·71	2·62	2·53	2·44	2·36
68	4·29	4·12	3·96	3·81	3·67	3·53	3·41	3·28	3·17	3·06	2·95	2·85	2·75	2·65	2·56	2·48
69	4·51	4·34	4·17	4·01	3·86	3·72	3·59	3·46	3·33	3·22	3·10	3·00	2·89	2·79	2·70	2·61
70	4·76	4·57	4·40	4·23	4·07	3·92	3·78	3·65	3·52	3·39	3·27	3·16	3·05	2·95	2·85	2·75
71	5·03	4·83	4·65	4·47	4·31	4·15	4·00	3·85	3·72	3·59	3·46	3·34	3·23	3·11	3·01	2·90
72	5·33	5·12	4·93	4·74	4·56	4·40	4·24	4·08	3·94	3·80	3·67	3·54	3·42	3·30	3·19	3·08
	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
	00	56	52	48	44	40	36	32	28	24	20	16	12	8	4	00
	10 Hr.	9 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	3 HOURS.															4 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 58	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	1·80	1·74	1·68	1·62	1·57	1·51	1·46	1·41	1·36	1·31	1·26	1·22	1·17	1·13	1·08	1·04
62	1·88	1·82	1·75	1·69	1·63	1·58	1·52	1·47	1·42	1·37	1·32	1·27	1·22	1·18	1·13	1·09
63	1·96	1·90	1·83	1·77	1·71	1·65	1·59	1·53	1·48	1·43	1·37	1·32	1·27	1·23	1·18	1·13
64	2·05	1·98	1·91	1·85	1·78	1·72	1·66	1·60	1·55	1·49	1·44	1·38	1·33	1·28	1·23	1·18
65	2·14	2·07	2·00	1·93	1·86	1·80	1·74	1·68	1·62	1·56	1·50	1·45	1·39	1·34	1·29	1·24
66	2·25	2·17	2·09	2·02	1·95	1·88	1·82	1·75	1·69	1·63	1·57	1·51	1·46	1·40	1·35	1·30
67	2·36	2·28	2·20	2·12	2·05	1·98	1·91	1·84	1·78	1·71	1·65	1·59	1·53	1·47	1·42	1·36
68	2·48	2·39	2·31	2·23	2·15	2·08	2·00	1·93	1·87	1·80	1·73	1·67	1·61	1·55	1·49	1·43
69	2·61	2·52	2·43	2·35	2·26	2·19	2·11	2·04	1·96	1·89	1·82	1·76	1·69	1·63	1·57	1·50
70	2·75	2·65	2·56	2·47	2·39	2·31	2·22	2·15	2·07	2·00	1·92	1·85	1·78	1·72	1·65	1·59
71	2·90	2·80	2·71	2·61	2·52	2·44	2·35	2·27	2·19	2·11	2·03	1·96	1·89	1·81	1·75	1·68
72	3·08	2·97	2·87	2·77	2·68	2·58	2·49	2·40	2·32	2·24	2·16	2·08	2·00	1·92	1·85	1·78
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	9 Hr.	8 HOURS.														

Lat.	4 HOURS.															5 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	1·04	1·00	·96	·92	·88	·84	·80	·77	·73	·69	·66	·62	·59	·55	·52	·48
62	1·09	1·04	1·00	·96	·92	·88	·84	·80	·76	·72	·68	·65	·61	·57	·54	·50
63	1·13	1·09	1·04	1·00	·96	·92	·87	·83	·79	·75	·71	·68	·64	·60	·56	·53
64	1·18	1·14	1·09	1·04	1·00	·96	·91	·87	·83	·79	·75	·71	·67	·63	·59	·55
65	1·24	1·19	1·14	1·09	1·05	1·00	·95	·91	·87	·82	·78	·74	·70	·66	·61	·57
66	1·30	1·24	1·19	1·14	1·10	1·05	1·00	·95	·91	·86	·82	·77	·73	·69	·64	·60
67	1·36	1·31	1·25	1·20	1·15	1·10	1·05	1·00	·95	·90	·86	·81	·77	·72	·68	·63
68	1·43	1·37	1·32	1·26	1·21	1·15	1·10	1·05	1·00	·95	·90	·85	·80	·76	·71	·66
69	1·50	1·44	1·39	1·33	1·27	1·21	1·16	1·11	1·05	1·00	·95	·90	·85	·80	·75	·70
70	1·59	1·52	1·46	1·40	1·34	1·28	1·22	1·17	1·11	1·05	1·00	·95	·89	·84	·79	·74
71	1·68	1·61	1·54	1·48	1·42	1·35	1·29	1·23	1·17	1·11	1·06	1·00	·94	·89	·83	·78
72	1·78	1·71	1·64	1·57	1·50	1·44	1·37	1·31	1·24	1·18	1·12	1·06	1·00	·94	·88	·82
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	8 Hr.	7 HOURS.														

Lat.	5 HOURS.															6 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 58	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
61	·483	·450	·416	·383	·351	·318	·286	·254	·222	·190	·158	·126	·095	·063	·031	·000
62	·504	·469	·434	·400	·366	·332	·298	·264	·231	·198	·165	·132	·099	·066	·033	·000
63	·526	·489	·453	·417	·381	·346	·311	·276	·241	·206	·172	·137	·103	·069	·034	·000
64	·549	·511	·473	·436	·399	·362	·325	·288	·252	·215	·179	·143	·107	·072	·036	·000
65	·575	·535	·495	·456	·417	·378	·340	·301	·263	·225	·188	·150	·112	·075	·037	·000
66	·602	·560	·519	·477	·437	·396	·356	·316	·276	·236	·197	·157	·118	·078	·039	·000
67	·631	·587	·544	·501	·458	·415	·373	·331	·289	·248	·206	·165	·123	·082	·041	·000
68	·663	·617	·571	·526	·481	·436	·392	·348	·304	·260	·217	·173	·130	·086	·043	·000
69	·698	·650	·601	·554	·506	·459	·413	·366	·320	·274	·228	·182	·137	·091	·045	·000
70	·736	·685	·634	·584	·534	·484	·435	·386	·337	·289	·240	·192	·144	·096	·048	·000
71	·778	·724	·670	·617	·565	·512	·460	·408	·357	·305	·254	·203	·152	·101	·051	·000
72	·825	·767	·711	·654	·598	·543	·487	·433	·378	·323	·269	·215	·161	·107	·054	·000
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	7 Hr.	6 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	0 HOUR.																1 Hr.
	m. 1	Var. to 1′ of L.	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	″	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	750	47	187	94	62	47	37	31	26·6	23·3	20·7	18·5	16·8	15·4	14·2	13·1	12·2
74	799	53	200	100	67	50	40	33	28·4	24·8	22·0	19·8	17·9	16·4	15·1	14·0	13·0
75	855	60	214	107	71	53	43	36	30·4	26·6	23·6	21·2	19·2	17·6	16·2	15·0	13·9
76	919	69	230	115	77	57	46	38	32·7	28·5	25·3	22·7	20·6	18·9	17·4	16·1	15·0
77	993	80	248	124	83	62	50	41	35·3	30·8	27·3	24·6	22·3	20·4	18·8	17·4	16·2
78	1078	93	270	135	90	67	54	45	38·3	33·5	29·7	26·7	24·2	22·1	20·4	18·9	17·6
79	1179	111	295	147	98	74	59	49	41·9	36·6	32·5	29·2	26·5	24·2	22·3	20·6	19·2
80	1300	134	325	162	108	81	65	54	46·2	40·4	35·8	32·2	29·2	26·7	24·6	22·7	21·2
81	1447	165	362	181	120	90	72	60	51·4	44·9	39·9	35·8	32·5	29·7	27·3	25·3	23·6
82	1631	210	408	204	136	102	81	68	58·0	50·6	44·9	40·4	36·6	33·5	30·8	28·5	26·6
83	1867	275	467	233	155	116	93	77	66·3	58·0	51·4	46·2	41·9	38·3	35·3	32·7	30·4
84	2181	377	545	272	181	136	109	91	77·5	67·7	60·1	54·0	48·9	44·8	41·2	38·2	35·5
85	2620	548	655	327	218	163	131	109	93·1	81·3	72·2	64·8	58·8	53·8	49·5	45·8	42·7
	m. 59	..	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	11 HOURS.																

Lat.	1 HOUR.																2 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	12·2	11·4	10·7	10·1	9·5	9·0	8·5	8·1	7·7	7·3	7·0	6·7	6·4	6·2	5·9	5·7
74	13·0	12·2	11·4	10·7	10·1	9·6	9·1	8·6	8·2	7·8	7·5	7·2	6·8	6·6	6·3	6·0
75	13·9	13·0	12·2	11·5	10·8	10·3	9·7	9·2	8·8	8·4	8·0	7·7	7·3	7·0	6·7	6·5
76	15·0	14·0	13·1	12·3	11·6	11·0	10·4	9·9	9·4	9·0	8·6	8·2	7·9	7·5	7·2	6·9
77	16·2	15·1	14·2	13·3	12·6	11·9	11·3	10·7	10·2	9·7	9·3	8·9	8·5	8·1	7·8	7·5
78	17·6	16·4	15·4	14·5	13·7	12·9	12·3	11·6	11·1	10·6	10·1	9·6	9·2	8·8	8·5	8·2
79	19·2	17·9	16·8	15·8	14·9	14·1	13·4	12·7	12·1	11·6	11·0	10·5	10·1	9·7	9·3	9·0
80	21·2	19·8	18·5	17·5	16·5	15·6	14·8	14·0	13·4	12·7	12·2	11·6	11·1	10·7	10·2	9·8
81	23·6	22·0	20·7	19·4	18·3	17·3	16·4	15·6	14·9	14·2	13·5	12·9	12·4	11·9	11·4	10·9
82	26·6	24·8	23·3	21·9	20·7	19·5	18·5	17·6	16·8	16·0	15·3	14·6	14·0	13·4	12·8	12·3
83	30·4	28·4	26·6	25·1	23·7	22·4	21·7	20·2	19·2	18·3	17·5	16·7	16·0	15·3	14·7	14·1
84	35·5	33·2	31·1	29·3	27·6	26·1	24·8	23·5	22·4	21·4	20·4	19·5	18·7	17·9	17·2	16·5
85	42·7	39·9	37·4	35·2	33·2	31·4	29·8	28·3	26·9	25·7	24·5	23·4	22·4	21·5	20·6	19·8
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	11 Hr.	10 HOURS.														

Lat.	2 HOURS.																3 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	5·7	5·4	5·2	5·0	4·8	4·7	4·5	4·3	4·2	4·0	3·9	3·8	3·6	3·5	3·4	3·3
74	6·0	5·8	5·6	5·4	5·2	5·0	4·8	4·6	4·5	4·3	4·2	4·0	3·9	3·7	3·6	3·5
75	6·5	6·2	6·0	5·7	5·5	5·3	5·1	5·0	4·8	4·6	4·4	4·3	4·1	4·0	3·9	3·7
76	6·9	6·7	6·4	6·2	5·9	5·7	5·5	5·3	5·1	5·0	4·8	4·6	4·5	4·3	4·2	4·0
77	7·5	7·2	6·9	6·7	6·4	6·2	6·0	5·7	5·5	5·3	5·2	5·0	4·8	4·6	4·5	4·3
78	8·1	7·8	7·5	7·2	7·0	6·7	6·5	6·2	6·0	5·8	5·6	5·4	5·2	5·0	4·9	4·7
79	8·9	8·6	8·2	7·9	7·6	7·3	7·1	6·8	6·6	6·4	6·1	5·9	5·7	5·5	5·3	5·1
80	9·8	9·4	9·1	8·7	8·4	8·1	7·8	7·5	7·3	7·0	6·8	6·5	6·3	6·1	5·9	5·7
81	10·9	10·5	10·1	9·7	9·4	9·0	8·7	8·4	8·1	7·8	7·5	7·3	7·0	6·8	6·5	6·3
82	12·3	11·8	11·4	11·0	10·5	10·2	9·8	9·4	9·1	8·8	8·5	8·2	7·9	7·6	7·4	7·1
83	14·1	13·6	13·0	12·5	12·1	11·6	11·2	10·8	10·4	10·1	9·7	9·4	9·0	8·7	8·4	8·1
84	16·5	15·8	15·2	14·7	14·1	13·6	13·1	12·6	12·2	11·7	11·3	10·9	10·6	10·2	9·9	9·5
85	19·8	19·0	18·3	17·6	16·9	16·3	15·7	15·2	14·6	14·1	13·6	13·1	12·7	12·3	11·8	11·4
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	10 Hr.	9 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	3 HOURS.															4 Hr.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	3·3	3·2	3·1	2·9	2·84	2·74	2·65	2·56	2·46	2·38	2·29	2·21	2·12	2·04	1·97	1·89
74	3·5	3·4	3·3	3·1	3·03	2·93	2·82	2·72	2·63	2·53	2·44	2·35	2·26	2·18	2·10	2·01
75	3·7	3·6	3·5	3·4	3·24	3·13	3·02	2·92	2·81	2·71	2·61	2·52	2·42	2·33	2·24	2·15
76	4·0	3·9	3·7	3·6	3·49	3·37	3·25	3·13	3·02	2·91	2·81	2·71	2·60	2·51	2·41	2·32
77	4·3	4·2	4·0	3·9	3·77	3·63	3·51	3·38	3·26	3·15	3·03	2·92	2·81	2·71	2·60	2·50
78	4·7	4·5	4·4	4·2	4·09	3·95	3·81	3·68	3·55	3·42	3·29	3·17	3·06	2·94	2·83	2·72
79	5·1	5·0	4·8	4·6	4·47	4·32	4·17	4·02	3·88	3·74	3·60	3·47	3·34	3·21	3·09	2·97
80	5·7	5·5	5·3	5·1	4·93	4·76	4·59	4·43	4·27	4·12	3·97	3·83	3·68	3·54	3·41	3·27
81	6·3	6·1	5·9	5·7	5·49	5·30	5·11	4·93	4·76	4·59	4·42	4·26	4·10	3·95	3·79	3·65
82	7·1	6·9	6·6	6·4	6·19	5·97	5·76	5·56	5·36	5·17	4·98	4·80	4·62	4·45	4·28	4·11
83	8·1	7·9	7·6	7·3	7·08	6·83	6·60	6·36	6·14	5·92	5·70	5·49	5·29	5·09	4·89	4 70
84	9·5	9·2	8·9	8·6	8·27	7·98	7·70	7·43	7·17	6·91	6·66	6·42	6·18	5·95	5·72	5·49
85	11·4	11·0	10·7	10·3	9·94	9·59	9·26	8·93	8·61	8·30	8·00	7·71	7·42	7·14	6·87	6·60
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	9 Hr.	8 HOURS.														

Lat.	4 HOURS.															5 Hr
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m 28	m. 32	m. 36	m 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	1·89	1·81	1·74	1·67	1·60	1·53	1·46	1·39	1·32	1·26	1·19	1·13	1·06	1·00	·94	·88
74	2·01	1·93	1·85	1·78	1·70	1·63	1·55	1·48	1·41	1·34	1·27	1·20	1·13	1·07	1·00	·93
75	2·15	2·07	1·98	1·90	1·82	1·74	1·66	1·58	1·51	1·43	1·36	1·29	1·21	1·14	1·07	1·00
76	2·32	2·22	2·13	2·04	1·96	1·87	1·79	1·70	1·62	1·54	1·46	1·38	1·30	1·23	1·15	1·07
77	2·50	2·40	2·30	2·21	2·11	2·02	1·93	1·84	1·75	1·66	1·58	1·49	1·41	1·32	1·24	1·16
78	2·72	2·61	2·50	2·40	2·29	2·19	2·09	2·00	1·90	1·81	1·71	1·62	1·53	1·44	1·35	1·26
79	2·97	2·85	2·74	2·62	2·51	2·40	2·29	2·18	2·08	1·97	1·87	1·77	1·67	1·57	1·48	1·38
80	3·27	3·14	3·02	2·89	2·77	2·64	2·53	2·41	2·29	2·18	2·06	1·95	1·84	1·73	1·63	1·52
81	3·65	3·50	3·36	3·22	3·08	2·94	2·81	2·68	2·55	2·42	2·30	2·17	2·05	1·93	1·81	1·69
82	4·11	3·94	3·78	3·63	3·47	3·32	3·17	3·02	2·87	2·73	2·59	2·45	2·31	2·18	2·04	1·91
83	4·70	4·51	4·33	4·15	3·97	3·80	3·63	3·46	3·29	3·13	2·96	2·80	2·65	2·49	2·34	2·18
84	5·49	5·27	5·06	4·85	4·64	4·44	4·24	4·04	3·84	3·65	3·46	3·28	3·09	2·91	2·73	2·55
85	6·60	6·34	6·08	5·82	5·57	5·33	5·09	4·85	4·62	4·39	4·16	3·94	3·71	3·49	3·28	3·06
	m 00	m 56	m. 52	m. 48	m. 44	m. 40	m 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	8 Hr	7 HOURS.														

Lat	5 HOURS.															6 Hr.
	m. 00	m 4	m. 8	m 12	m. 16	m. 20	m. 24	m 28	m. 32	m 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
73	·88	·82	·76	·70	·64	·58	·52	·46	·40	·34	·29	·23	·17	·11	·06	·00
74	93	·87	·81	·74	·68	·61	·55	·49	·43	·37	·31	·24	·18	·12	·06	·00
75	1·00	·93	·86	·79	·73	·66	·59	·52	·46	·39	·33	·26	·20	·13	·07	·00
76	1·07	1·00	·93	·85	·78	·71	·64	·56	·49	·42	·35	·28	·21	·14	·07	·00
77	1·16	1·08	1·00	·92	·84	·76	·69	·61	·53	·46	·38	·30	·23	·15	·08	·00
78	1·26	1·17	1·09	1·00	·91	·83	·75	·66	·58	·49	·41	·33	·25	·16	·08	·00
79	1·38	1·28	1·19	1·09	1·00	·91	·81	·72	·63	·54	·45	·36	·27	·18	·09	·00
80	1·52	1·41	1·31	1·21	1·10	1·00	·90	·80	·70	·60	·50	·40	·30	·20	·10	·00
81	1·69	1·57	1·46	1·34	1·23	1·11	1·00	·89	·78	·66	·55	·44	·33	·22	·11	·00
82	1·91	1·77	1·64	1·51	1·38	1·25	1·13	1·00	·87	·75	·62	·50	·37	·25	·12	·00
83	2·18	2·03	1·88	1·73	1·58	1·44	1·29	1·14	1·00	·86	·71	·57	·43	·28	·14	·00
84	2·55	2·37	2·20	2·02	1·85	1·68	1·51	1·34	1·17	1·00	·83	·67	·50	·33	·17	·00
85	3·06	2·85	2·64	2·43	2·22	2·02	1·81	1·61	1·40	1·20	1·00	·80	·60	·40	·20	·00
	m. 00	m. 56	m. 25	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	7 Hr.	6 HOURS.														

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination	0 HOUR.																1 Hr.
	m. 1	Var. to 1′ of Decl.	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	″	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
30	132	5·33	33·1	16·5	11·0	8·28	6·62	5·52	4·74	4·15	3·69	3·32	3·03	2·78	2·57	2·39	2·23
31	138	5·44	34·4	17·2	11·5	8·61	6·89	5·75	4·93	4·32	3·84	3·46	3·15	2·89	2·67	2·48	2·32
32	143	5·56	35·8	17·9	11·9	8·96	7·17	5·98	5·13	4·49	3·99	3·60	3·27	3·01	2·78	2·58	2·41
33	149	5·69	37·2	18·6	12·4	9·31	7·45	6·21	5·33	4·67	4·15	3·74	3·40	3·12	2·89	2·68	2·51
34	155	5·82	38·6	19·3	12·9	9·67	7·74	6·45	5·53	4·85	4·31	3·88	3·53	3·24	3·00	2·79	2·61
35	160	5·96	40·1	20·1	13·4	10·0	8·03	6·70	5·75	5.03	4·48	4·03	3·67	3·37	3·11	2·89	2·71
36	167	6·11	41·6	20·8	13·9	10·4	8·34	6·95	5·96	5·22	4·64	4·18	3·81	3·49	3·23	3·00	2·81
37	173	6·27	43·2	21·6	14·4	10·8	8·65	7·21	6·18	5·41	4·82	4·34	3·95	3·62	3·35	3·11	2·91
38	179	6·44	44·8	22·4	14·9	11·2	8·96	7·47	6·41	5·61	4·99	4·50	4·09	3·76	3·47	3·23	3·02
39	186	6·62	46·4	23·2	15·5	11·6	9·29	7·75	6·64	5·82	5·18	4·66	4·24	3·89	3·60	3·35	3·13
40	192	6·82	48·1	24·0	16·0	12·0	9·63	8·03	6·89	6·03	5·36	4·83	4·40	4·04	3·73	3·47	3·24
41	199	7·03	49·8	24·9	16·6	12·5	9·97	8·32	7·13	6·25	5·56	5·01	4·56	4·18	3·86	3·59	3·36
42	206	7·25	51·6	25·8	17·2	12·9	10·3	8·61	7·39	6·47	5·76	5·19	4·72	4·33	4·00	3·72	3·48
43	214	7·48	53·4	26·7	17·8	13·4	10·7	8·92	7·65	6·70	5·96	5·37	4·89	4·49	4·15	3·85	3·60
44	221	7·73	55·3	27·7	18·5	13·8	11·1	9·24	7·92	6·94	6·17	5·56	5·06	4·64	4·29	3·99	3·73
45	229	8·00	57·3	28·7	19·1	14·3	11·5	9·57	8·21	7·19	6·39	5·76	5·24	4·81	4·45	4·13	3·86
46	237	8·29	59·3	29·7	19·8	14·8	11·9	9·91	8·50	7·44	6·62	5·96	5·43	4·98	4·60	4·28	4·00
47	246	8·60	61·4	30·7	20·5	15·4	12·3	10·3	8·80	7·71	6·86	6·18	5·62	5·16	4·77	4·43	4·14
48	255	8·93	63·6	31·8	21·2	15·9	12·7	10·6	9·11	7·98	7·10	6·40	5·82	5·34	4·94	4·59	4·29
49	264	9·30	65·9	33·0	22·0	16·5	13·2	11·0	9·44	8·27	7·35	6·62	6·03	5·53	5·11	4·76	4·44
50	273	9·69	68·3	34·1	22·8	17·1	13·7	11·4	9·78	8·56	7·62	6·86	6·25	5·73	5·30	4·93	4·60
51	283	10·1	70·8	35·4	23·6	17·7	14·2	11·8	10·1	8·87	7·89	7·11	6·47	5·94	5·49	5·10	4·77
52	293	10·6	73·3	36·7	24·5	18·3	14·7	12·2	10·5	9·20	8·18	7·37	6·71	6·16	5·69	5·29	4·95
53	304	11·1	76·0	38·0	25·4	19·0	15·2	12·7	10·9	9·54	8·48	7·64	6·95	6·38	5·90	5·49	5·13
54	315	11·6	78·9	39·4	26·3	19·7	15·8	13·2	11·3	9·89	8·80	7·93	7·21	6·62	6·12	5·69	5·32
55	327	12·2	81·8	40·9	27·3	20·5	16·4	13·7	11·7	10·3	9·13	8·22	7·48	6·87	6·35	5·90	5·52
56	340	12·8	84·9	42·5	28·3	21·3	17·0	14·2	12·2	10·7	9·48	8·54	7·77	7·13	6·59	6·13	5·73
57	353	13·5	88·2	44·1	29·4	22·1	17·7	14·7	12·6	11·1	9·84	8·87	8·07	7·41	6·85	6·37	5·95
58	367	14·3	91·7	45·9	30·6	22·9	18·4	15·3	13·1	11·5	10·2	9·22	8·39	7·70	7·11	6·62	6·18
59	381	15·1	95·4	47·7	31·8	23·9	19·1	15·9	13·7	12·0	10·6	9·58	8·72	8·00	7·40	6·88	6·43
60	397	16·0	99·2	49·6	33·1	24·8	19·9	16·6	14·2	12·4	11·1	9·97	9·08	8·33	7·70	7·16	6·69
61	413	17·0	103	51·7	34·5	25·9	20·7	17·3	14·8	13·0	11·5	10·4	9·45	8·68	8·02	7·46	6·97
62	431	18·2	108	53·9	35·9	27·0	21·6	18·0	15·4	13·5	12·0	10·8	9·86	9·05	8·36	7·77	7·27
63	450	19·4	112	56·2	37·5	28·1	22·5	18·8	16·1	14·1	12·5	11·3	10·3	9·44	8·72	8·11	7·58
64	470	20·1	117	58·7	39·2	29·4	23·5	19·6	16·8	14·7	13·1	11·8	10·7	9·86	9·11	8·48	7·92
65	491	22·4	123	61·4	41·0	30·7	24·6	20·5	17·6	15·4	13·7	12·3	11·2	10·3	9·53	8·86	8·29
66	515	24·2	129	64·4	42·9	32·2	25·8	21·5	18·4	16·1	14·4	12·9	11·8	10·8	9·98	9·28	8·68
67	540	26·2	135	67·5	45·0	33·8	27·0	22·5	19·3	16·9	15·1	13·6	12·3	11·3	10·5	9·74	9·10
68	567	28·6	142	70·9	47·3	35·5	28·4	23·7	20·3	17·8	15·8	14·3	13·0	11·9	11·0	10·2	9·56
69	597	31·2	149	74·6	49·8	37·3	29·9	24·9	21·4	18·7	16·7	15·0	13·7	12·5	11·6	10·8	10·1
70	630	34·3	157	78·7	52·5	39·4	31·5	26·3	22·5	19·7	17·6	15·8	14·4	13·2	12·2	11·4	10·6
71	666	37·8	166	83·2	55·5	41·6	33·3	27·8	23·8	20·9	18·6	16·7	15·2	14·0	12·9	12·0	11·2
72	705	42·0	176	88·2	58·8	44·1	35·3	29·4	25·3	22·1	19·7	17·7	16·1	14·8	13·7	12·7	11·9
73	750	47	187	93·7	62·5	46·9	37·5	31·3	26·8	23·5	20·9	18·8	17·1	15·7	14·5	13·5	12·6
74	799	53	200	99·9	66·6	50·0	40·0	33·4	28·6	25·1	22·3	20·1	18·3	16·8	15·5	14·4	13·5
75	855	60	214	107	71·3	53·5	42·8	35·7	30·6	26·8	23·9	21·5	19·6	18·0	16·6	15·4	14·4
76	919	69	230	115	76·6	57·5	46·0	38·4	32·9	28·8	25·6	23·1	21·0	19·3	17·8	16·6	15·5
77	993	80	248	124	82·8	62·1	49·7	41·4	35·5	31·1	27·7	24·9	22·7	20·8	19·3	17·9	16·7
78	1078	93	270	135	89·9	67·4	54·0	45·0	38·6	33·8	30·1	27·1	24·7	22·6	20·9	19·4	18·2
79	1179	111	295	147	98·3	73·8	59·0	49·2	42·2	37·0	32·9	29·6	27·0	24·7	22·9	21·3	19·9
80	1300	134	325	163	108	81·3	65·1	54·3	46·5	40·7	36·3	32·7	29·7	27·3	25·2	23·4	21·9
81	1447	165	362	181	121	90·5	72·4	60·4	51·8	45·4	40·4	36·4	33·1	30·4	28·0	26·1	24·4
82	1631	210	408	204	136	102	81·6	68·1	58·4	51·1	45·5	41·0	37·3	34·2	31·6	29·4	27·5
83	1867	276	467	233	156	117	93·4	77·9	66·8	58·5	52·1	46·9	42·7	39·2	36·2	33·7	31·5
84	2180	377	545	273	182	136	109	91·0	78·1	68·4	60·8	54·8	49·9	45·8	42·3	39·3	36·8
85	2620	548	655	328	218	164	131	109	93·8	82·1	73·1	65·8	59·9	55·0	50·8	47·2	44·2
	m. 59	..	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00

11 HOURS.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	1 HOUR.															2 Hrs.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 58	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
30	2·23	2·09	1·97	1·87	1·77	1·69	1·61	1·54	1·48	1·42	1·37	1·32	1·27	1·23	1·19	1·15
31	2·32	2·18	2·06	1·94	1·85	1·76	1·68	1·60	1·54	1·48	1·42	1·37	1·32	1·28	1·24	1·20
32	2·41	2·27	2·14	2·02	1·92	1·83	1·74	1·67	1·60	1·54	1·48	1·43	1·38	1·33	1·29	1·25
33	2·51	2·36	2·22	2·10	1·99	1·90	1·81	1·73	1·66	1·60	1·54	1·48	1·43	1·38	1·34	1·30
34	2·61	2·45	2·31	2·18	2·07	1·97	1·88	1·80	1·73	1·66	1·60	1·54	1·49	1·44	1·39	1·35
35	2·71	2·54	2·39	2·27	2·15	2·05	1·95	1·87	1·79	1·72	1·66	1·60	1·54	1·49	1·44	1·40
36	2·81	2·64	2·48	2·35	2·23	2·12	2·03	1·94	1·86	1·79	1·72	1·66	1·60	1·55	1·50	1·45
37	2·91	2·73	2·58	2·44	2·31	2·20	2·10	2·01	1·93	1·85	1·78	1·72	1·66	1·61	1·55	1·51
38	3·02	2·83	2·67	2·53	2·40	2·28	2·18	2·09	2·00	1·92	1·85	1·78	1·72	1·66	1·61	1·56
39	3·13	2·94	2·77	2·62	2·49	2·37	2·26	2·16	2·07	1·99	1·92	1·85	1·78	1·72	1·67	1·62
40	3·24	3·04	2·87	2·72	2·58	2·45	2·34	2·24	2·15	2·06	1·99	1·91	1·85	1·79	1·73	1·68
41	3·36	3·15	2·97	2·81	2·67	2·54	2·43	2·32	2·22	2·14	2·06	1·98	1·91	1·85	1·79	1·74
42	3·48	3·27	3·08	2·91	2·77	2·63	2·51	2·40	2·30	2·21	2·13	2·05	1·98	1·92	1·86	1·80
43	3·60	3·38	3·19	3·02	2·86	2·73	2·60	2·49	2·39	2·29	2·21	2·13	2·05	1·99	1·92	1·87
44	3·73	3·50	3·30	3·13	2·97	2·82	2·69	2·58	2·47	2·37	2·29	2·20	2·13	2·06	1·99	1·93
45	3·86	3·63	3·42	3·24	3·07	2·92	2·79	2·67	2·56	2·46	2·37	2·28	2·20	2·13	2·06	2·00
46	4·00	3·76	3·54	3·35	3·18	3·03	2·89	2·76	2·65	2·55	2·45	2·36	2·28	2·21	2·14	2·07
47	4·14	3·89	3·67	3·47	3·29	3·14	2·99	2·86	2·74	2·64	2·54	2·45	2·36	2·28	2·21	2·14
48	4·29	4·03	3·80	3·59	3·41	3·25	3·10	2·96	2·84	2·73	2·63	2·53	2·45	2·37	2·29	2·22
49	4·44	4·17	3·93	3·72	3·53	3·36	3·21	3·07	2·94	2·83	2·72	2·62	2·53	2·45	2·37	2·30
50	4·60	4·32	4·08	3·86	3·66	3·48	3·33	3·18	3·05	2·93	2·82	2·72	2·63	2·54	2·46	2·38
51	4·77	4·48	4·22	4·00	3·79	3·61	3·45	3·30	3·16	3·04	2·92	2·82	2·72	2·63	2·55	2·47
52	4·95	4·64	4·38	4·14	3·93	3·74	3·57	3·42	3·28	3·15	3·03	2·92	2·82	2·73	2·64	2·56
53	5·13	4·81	4·54	4·29	4·08	3·88	3·70	3·54	3·40	3·26	3·14	3·03	2·92	2·83	2·74	2·65
54	5·32	4·99	4·71	4·54	4·23	4·02	3·84	3·67	3·52	3·38	3·26	3·14	3·03	2·93	2·84	2·75
55	5·52	5·18	4·88	4·62	4·39	4·18	3·99	3·81	3·66	3·51	3·38	3·26	3·15	3·04	2·95	2·86
56	5·73	5·38	5·07	4·80	4·55	4·33	4·14	3·96	3·79	3·65	3·51	3·38	3·27	3·16	3·06	2·97
57	5·95	5·59	5·27	4·98	4·73	4·50	4·30	4·11	3·94	3·79	3·64	3·51	3·39	3·28	3·18	3·08
58	6·18	5·81	5·47	5·18	4·92	4·68	4·47	4·27	4·10	3·93	3·79	3·65	3·53	3·41	3·30	3·20
59	6·43	6·04	5·69	5·39	5·11	4·87	4·64	4·44	4·26	4·09	3·94	3·80	3·67	3·55	3·43	3·33
60	6·69	6·28	5·92	5·61	5·32	5·06	4·83	4·62	4·43	4·26	4·10	3·95	3·82	3·69	3·57	3·46
61	6·97	6·55	6·17	5·84	5·54	5·27	5·03	4·82	4·62	4·44	4·27	4·12	3·97	3·84	3·72	3·61
62	7·27	6·82	6·43	6·09	5·78	5·50	5·25	5.02	4·81	4·62	4·45	4·29	4·14	4·01	3·88	3·76
63	7·58	7·12	6·71	6·35	6·03	5·74	5·48	5·24	5·02	4·83	4·64	4·48	4·32	4·18	4·05	3·93
64	7·92	7·44	7·01	6·63	6·30	5·99	5·72	5·47	5·25	5·04	4·85	4·68	4·52	4·37	4·23	4·10
65	8·29	7·78	7·33	6·94	6·59	6·27	5·98	5·72	5·49	5·27	5·07	4·89	4·72	4·57	4·42	4·29
66	8·68	8·15	7·68	7·27	6·90	6·57	6·27	6·00	5·75	5·52	5·31	5·12	4·95	4·78	4·63	4·49
67	9·10	8·55	8·06	7·62	7·24	6·89	6·57	6·29	6·03	5·79	5·57	5·37	5·19	5·02	4·86	4·71
68	9·56	8·98	8·47	8·01	7·60	7·24	6·91	6·61	6·33	6·09	5·86	5·65	5·45	5·27	5·11	4·95
69	10·1	9·45	8·91	8·43	8·00	7·62	7·27	6·95	6·67	6·40	6·16	5·94	5·74	5·55	5·37	5·21
70	10·6	9·97	9·40	8·89	8·44	8·03	7·67	7·33	7·03	6·75	6·50	6·27	6·05	5·85	5·67	5·49
71	11·2	10·5	9·93	9·40	8·92	8·49	8·10	7·75	7·43	7·14	6·87	6·63	6·40	6·19	5·99	5·81
72	11·9	11·2	10·5	9·96	9·45	9·00	8·59	8·22	7·88	7·57	7·28	7·02	6·78	6·56	6·35	6·16
73	12·6	11·9	11·2	10·6	10·0	9·56	9·13	8·73	8·37	8·04	7·74	7·46	7·20	6·97	6·75	6·54
74	13·5	12·7	11·9	11·3	10·7	10·2	9·73	9·31	8·93	8·57	8·25	7·96	7·68	7·43	7·19	6·97
75	14·4	13·5	12·8	12·1	11·5	10·9	10·4	9·96	9·55	9·18	8·83	8·51	8·22	7·95	7·70	7·46
76	15·5	14·6	13·7	13·0	12·3	11·7	11·2	10·7	10·3	9·86	9·49	9·15	8·83	8·54	8·27	8·02
77	16·7	15·7	14·8	14·0	13·3	12·7	12·1	11·6	11·1	10·6	10·2	9·88	9·54	9·23	8·93	8·66
78	18·2	17·1	16·1	15·2	14·5	13·8	13·1	12·6	12·0	11·6	11·1	10·7	10·4	10·0	9·70	9·41
79	19·9	18·7	17·6	16·6	15·8	15·0	14·4	13·7	13·2	12·6	12·2	11·7	11·3	11·0	10·6	10·3
80	21·9	20·6	19·4	18·4	17·4	16·6	15·8	15·1	14·5	13·9	13·4	12·9	12·5	12·1	11·7	11·3
81	24·4	22·9	21·6	20·4	19·4	18·5	17·6	16·9	16·2	15·5	14·9	14·4	13·9	13·4	13·0	12·6
82	27·5	25·8	24·3	23·0	21·9	20·8	19·9	19·0	18·2	17·5	16·8	16·2	15·7	15·2	14·7	14·2
83	31·5	29·5	27·9	26·4	25·0	23·8	22·7	21·7	20·8	20·0	19·3	18·6	17·9	17·3	16·8	16·3
84	36·8	34·5	32·5	30·8	29·2	27·8	26·5	25·4	24·4	23·4	22·5	21·7	21·0	20·3	19·6	19·0
85	44·2	41·5	39·1	37·0	35·1	33·4	31·9	30·5	29·3	28·1	27·0	26·1	25·2	24·3	23·6	22·9
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	11 Hrs.	10 HOURS.														

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	2 HOURS.															3 Hrs.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
30	1·15	1·12	1·09	1·06	1·03	1·01	·98	·96	·94	·92	·90	·88	·86	·85	·83	·82
31	1·20	1·17	1·13	1·10	1·07	1·05	1·02	1·00	·98	·95	·93	·92	·90	·88	·86	·85
32	1·25	1·21	1·18	1·15	1·12	1·09	1·06	1·04	1·01	·99	·97	·95	·93	·92	·90	·88
33	1·30	1·26	1·23	1·19	1·16	1·13	1·10	1·08	1·05	1·03	1·01	·99	·97	·95	·93	·92
34	1·35	1·31	1·27	1·24	1·21	1·18	1·15	1·12	1·10	1·07	1·05	1·03	1·01	·99	·97	·95
35	1·40	1·36	1·32	1·29	1·25	1·22	1·19	1·16	1·14	1·11	1·09	1·07	1·05	1·03	1·01	·99
36	1·45	1·41	1·37	1·33	1·30	1·27	1·24	1·21	1·18	1·15	1·13	1·11	1·09	1·07	1·05	1·03
37	1·51	1·46	1·42	1·38	1·35	1·31	1·28	1·25	1·22	1·20	1·17	1·15	1·30	1·10	1·08	1·07
38	1·56	1·52	1·47	1·43	1·40	1·36	1·33	1·30	1·27	1·24	1·22	1·19	1·17	1·15	1·12	1·10
39	1·62	1·57	1·53	1·49	1·45	1·41	1·38	1·35	1·32	1·29	1·26	1·23	1·21	1·19	1·17	1·15
40	1·68	1·63	1·58	1·54	1·50	1·46	1·43	1·39	1·36	1·33	1·31	1·28	1·25	1·23	1·21	1·19
41	1·74	1·69	1·64	1·60	1·55	1·52	1·48	1·44	1·41	1·38	1·35	1·33	1·30	1·27	1·25	1·23
42	1·80	1·75	1·70	1·65	1·61	1·57	1·53	1·50	1·46	1·43	1·40	1·37	1·35	1·32	1·30	1·27
43	1·87	1·81	1·76	1·71	1·67	1·63	1·59	1·55	1·51	1·48	1·45	1·42	1·39	1·37	1·34	1·32
44	1·93	1·87	1·82	1·77	1·73	1·68	1·64	1·60	1·57	1·53	1·50	1·47	1·44	1·42	1·39	1·37
45	2·00	1·94	1·89	1·84	1·79	1·74	1·70	1·66	1·62	1·59	1·56	1·52	1·49	1·47	1·44	1·41
46	2·07	2·01	1·95	1·90	1·85	1·81	1·76	1·72	1·68	1·65	1·61	1·58	1·55	1·52	1·49	1·46
47	2·14	2·08	2·02	1·97	1·92	1·87	1·82	1·78	1·74	1·70	1·67	1·63	1·60	1·57	1·54	1·52
48	2·22	2·16	2·10	2·04	1·99	1·94	1·89	1·85	1·80	1·76	1·73	1·69	1·66	1·63	1·60	1·57
49	2·30	2·23	2·17	2·11	2·06	2·01	1·96	1·91	1·87	1·83	1·79	1·75	1·72	1·69	1·66	1·63
50	2·38	2·31	2·25	2·19	2·13	2·08	2·03	1·98	1·94	1·89	1·85	1·82	1·78	1·75	1·72	1·69
51	2·47	2·40	2·33	2·27	2·21	2·15	2·10	2·05	2·01	1·96	1·92	1·88	1·85	1·81	1·78	1·75
52	2·56	2·49	2·42	2·35	2·29	2·23	2·18	2·13	2·08	2·03	1·99	1·95	1·91	1·88	1·84	1·81
53	2·65	2·58	2·50	2·44	2·37	2·31	2·26	2·21	2·16	2·11	2·06	2·02	1·98	1·95	1·91	1·88
54	2·75	2·67	2·60	2·53	2·46	2·40	2·34	2·29	2·24	2·19	2·14	2·10	2·06	2·02	1·98	1·95
55	2·86	2·77	2·70	2·62	2·55	2·49	2·43	2·37	2·32	2·27	2·22	2·18	2·13	2·09	2·06	2·02
56	2·97	2·88	2·80	2·72	2·65	2·58	2·52	2·46	2·41	2·36	2·31	2·26	2·22	2·17	2·13	2·10
57	3·08	2·99	2·91	2·83	2·75	2·68	2·62	2·56	2·50	2·45	2·40	2·35	2·30	2·26	2·22	2·18
58	3·20	3·11	3·02	2·94	2·86	2·79	2·72	2·66	2·60	2·54	2·49	2·44	2·39	2·35	2·30	2·26
59	3·33	3·23	3·14	3·06	2·98	2·90	2·83	2·77	2·70	2·64	2·59	2·54	2·49	2·44	2·40	2·35
60	3·46	3·36	3·27	3·18	3·10	3·02	2·95	2·88	2·81	2·75	2·69	2·64	2·59	2·54	2·49	2·45
61	3·61	3·50	3·40	3·31	3·23	3·15	3·07	3·00	2·93	2·87	2·81	2·75	2·70	2·65	2·60	2·55
62	3·76	3·65	3·55	3·45	3·36	3·28	3·20	3·13	3·05	2·99	2·93	2·87	2·81	2·76	2·71	2·66
63	3·93	3·81	3·70	3·60	3·51	3·42	3·34	3·26	3·19	3·12	3·05	2·99	2·93	2·88	2·83	2·78
64	4·10	3·98	3·87	3·76	3·67	3·57	3·49	3·41	3·33	3·26	3·19	3·13	3·06	3·01	2·95	2·90
65	4·29	4·16	4·05	3·94	3·84	3·74	3·65	3·56	3·48	3·41	3·34	3·27	3·20	3·14	3·09	3·03
66	4·49	4·36	4·24	4·12	4·02	3·92	3·82	3·73	3·65	3·57	3·49	3·42	3·36	3·29	3·23	3·18
67	4·71	4·57	4·45	4·33	4·21	4·11	4·01	3·91	3·83	3·74	3·67	3·58	3·52	3·45	3·39	3·33
68	4·95	4·81	4·67	4·54	4·43	4·32	4·21	4·11	4·02	3·93	3·85	3·77	3·70	3·63	3·56	3·50
69	5·21	5·06	4·92	4·78	4·66	4·54	4·43	4·33	4·23	4·14	4·05	3·97	3·89	3·82	3·75	3·68
70	5·49	5·33	5·18	5·04	4·91	4·79	4·67	4·57	4·46	4·37	4·27	4·19	4·11	4·03	3·96	3·89
71	5·81	5·64	5·48	5·33	5·19	5·06	4·94	4·83	4·72	4·61	4·52	4·43	4·34	4·26	4·18	4·11
72	6·16	5·98	5·81	5·65	5·50	5·37	5·24	5·11	5·00	4·89	4·79	4·69	4·60	4·51	4·43	4·35
73	6·54	6·35	6·17	6·01	5·85	5·70	5·56	5·43	5·31	5·20	5·09	4·99	4·89	4·80	4·71	4·63
74	6·97	6·77	6·58	6·40	6·24	6·08	5·93	5·79	5·66	5·54	5·43	5·32	5·21	5·11	5·02	4·93
75	7·46	7·25	7·04	6·85	6·67	6·51	6·35	6·20	6·06	5·93	5·81	5·69	5·58	5·47	5·37	5·28
76	8·02	7·79	7·57	7·36	7·17	6·99	6·82	6·66	6·51	6·37	6·24	6·11	5·99	5·88	5·77	5·67
77	8·66	8·41	8·17	7·95	7·75	7·55	7·37	7·20	7·04	6·88	6·74	6·60	6·47	6·35	6·24	6·13
78	9·41	9·13	8·88	8·64	8·41	8·20	8·00	7·82	7·64	7·48	7·32	7·17	7·03	6·90	6·77	6·65
79	10·3	9·99	9·71	9·45	9·20	8·97	8·75	8·55	8·36	8·17	8·00	7·84	7·69	7·54	7·41	7·28
80	11·3	11·0	10·7	10·4	10·1	9·89	9·65	9·42	9·21	9·01	8·82	8·64	8·48	8·32	8·16	8·02
81	12·6	12·3	11·9	11·6	11·3	11·0	10·7	10·5	10·3	10·0	9·82	9·62	9·44	9·26	9·09	8·93
82	14·2	13·8	13·4	13·1	12·7	12·4	12·1	11·8	11·6	11·3	11·1	10·8	10·6	10·4	10·2	10·1
83	16·3	15·8	15·4	15·0	14·6	14·2	13·9	13·5	13·2	12·9	12·7	12·4	12·2	11·9	11·7	11·5
84	19·0	18·5	18·0	17·5	17·0	16·6	16·2	15·8	15·5	15·1	14·8	14·5	14·2	14·0	13·7	13·5
85	22·9	22·2	21·6	21·0	20·4	19·9	19·4	19·0	18·6	18·2	17·8	17·4	17·1	16·8	16·5	16·2
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	10 Hrs.	9 HOURS.														

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	8 HOURS.															4 Hrs.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
30	·82	·80	·79	·78	·76	·75	·74	·73	·72	·71	·70	·70	·69	·68	·67	·67
31	·85	·84	·82	·81	·80	·78	·77	·76	·75	·74	·73	·72	·72	·71	·70	·69
32	·88	·87	·85	·84	·83	·82	·80	·79	·78	·77	·76	·75	·75	·74	·73	·72
33	·92	·90	·89	·87	·86	·85	·84	·82	·81	·80	·79	·78	·77	·77	·76	·75
34	·95	·94	·92	·91	·89	·88	·87	·86	·84	·83	·82	·81	·80	·80	·79	·78
35	·99	·97	·96	·94	·93	·91	·90	·89	·88	·87	·85	·84	·83	·83	·82	·81
36	1·03	1·01	·99	·98	·96	·95	·93	·92	·91	·90	·89	·88	·87	·86	·85	·84
37	1·07	1·05	1·03	1·01	1·00	·98	·97	·96	·94	·93	·92	·91	·90	·89	·88	·87
38	1·10	1·09	1·07	1·05	1·04	1·02	1·01	·99	·98	·97	·95	·94	·93	·92	·91	·90
39	1·15	1·13	1·11	1·09	1·07	1·06	1·04	1·03	1·01	1·00	·99	·98	·97	·95	·94	·94
40	1·19	1·17	1·15	1·13	1·11	1·10	1·08	1·06	1·05	1·04	1·02	1·01	1·00	·99	·98	·97
41	1·23	1·21	1·19	1·17	1·15	1·13	1·12	1·10	1·09	1·07	1·06	1·05	1·04	1·03	1·01	1·00
42	1·27	1·25	1·23	1·21	1·19	1·18	1·16	1·14	1·13	1·11	1·10	1·09	1·07	1·06	1·05	1·04
43	1·32	1·30	1·28	1·25	1·24	1·22	1·20	1·18	1·17	1·15	1·14	1·12	1·11	1·10	1·09	1·08
44	1·37	1·34	1·32	1·30	1·28	1·26	1·24	1·23	1·21	1·19	1·18	1·16	1·15	1·14	1·13	1·12
45	1·41	1·39	1·37	1·35	1·33	1·31	1·29	1·27	1·25	1·24	1·22	1·21	1·19	1·18	1·17	1·15
46	1·46	1·44	1·42	1·39	1·37	1·35	1·33	1·31	1·30	1·28	1·26	1·25	1·23	1·22	1·21	1·20
47	1·52	1·49	1·47	1·44	1·42	1·40	1·38	1·36	1·34	1·33	1·31	1·29	1·28	1·26	1·25	1·24
48	1·57	1·54	1·52	1·49	1·47	1·45	1·43	1·41	1·39	1·37	1·36	1·34	1·32	1·31	1·30	1·28
49	1·63	1·60	1·57	1·55	1·52	1·50	1·48	1·46	1·44	1·42	1·40	1·39	1·37	1·36	1·34	1·33
50	1·69	1·66	1·63	1·60	1·58	1·56	1·53	1·51	1·49	1·47	1·45	1·44	1·42	1·41	1·39	1·38
51	1·75	1·72	1·69	1·66	1·64	1·61	1·59	1·57	1·55	1·53	1·51	1·49	1·47	1·46	1·44	1·43
52	1·81	1·78	1·75	1·72	1·70	1·67	1·65	1·62	1·60	1·58	1·56	1·54	1·53	1·51	1·49	1·48
53	1·88	1·84	1·81	1·79	1·76	1·73	1·71	1·68	1·66	1·64	1·62	1·60	1·58	1·56	1·55	1·53
54	1·95	1·91	1·88	1·85	1·82	1·80	1·77	1·75	1·72	1·70	1·68	1·66	1·64	1·62	1·61	1·59
55	2·02	1·99	1·95	1·92	1·89	1·86	1·84	1·81	1·79	1·77	1·74	1·72	1·70	1·68	1·67	1·65
56	2·10	2·06	2·03	1·99	1·96	1·94	1·91	1·88	1·86	1·83	1·81	1·79	1·77	1·75	1·73	1·71
57	2·18	2·14	2·11	2·07	2·04	2·01	1·98	1·95	1·93	1·90	1·88	1·86	1·84	1·82	1·80	1·78
58	2·26	2·22	2·19	2·15	2·12	2·09	2·06	2·03	2·00	1·98	1·95	1·93	1·91	1·89	1·87	1·85
59	2·35	2·31	2·28	2·24	2·21	2·17	2·14	2·11	2·08	2·06	2·03	2·01	1·98	1·96	1·94	1·92
60	2·45	2·41	2·37	2·33	2·29	2·26	2·23	2·20	2·17	2·14	2·11	2·09	2·07	2·04	2·02	2·00
61	2·55	2·51	2·47	2·43	2·39	2·36	2·32	2·29	2·26	2·23	2·20	2·18	2·15	2·13	2·10	2·08
62	2·66	2·61	2·57	2·53	2·49	2·46	2·42	2·39	2·35	2·32	2·30	2·27	2·24	2·22	2·19	2·17
63	2·78	2·73	2·68	2·64	2·60	2·56	2·53	2·49	2·46	2·43	2·40	2·37	2·34	2·31	2·29	2·27
64	2·90	2·85	2·80	2·76	2·72	2·68	2·64	2·60	2·57	2·53	2·50	2·47	2·44	2·42	2·39	2·37
65	3·03	2·98	2·93	2·89	2·84	2·80	2·76	2·72	2·69	2·65	2·62	2·59	2·56	2·53	2·50	2·48
66	3·18	3·12	3·07	3·02	2·98	2·93	2·89	2·85	2·81	2·78	2·74	2·71	2·68	2·65	2·62	2·59
67	3·33	3·28	3·22	3·17	3·12	3·08	3·03	2·99	2·95	2·91	2·88	2·84	2·81	2·78	2·75	2·72
68	3·50	3·44	3·38	3·33	3·28	3·23	3·18	3·14	3·10	3·06	3·02	2·99	2·95	2·92	2·89	2·86
69	3·68	3·62	3·56	3·51	3·45	3·40	3·35	3·31	3·26	3·22	3·18	3·14	3·11	3·07	3·04	3·01
70	3·89	3·82	3·76	3·70	3·64	3·59	3·54	3·49	3·44	3·40	3·35	3·31	3·28	3·24	3·21	3·17
71	4·11	4·04	3·97	3·91	3·85	3·79	3·74	3·69	3·64	3·59	3·55	3·50	3·46	3·42	3·39	3·35
72	4·35	4·28	4·21	4·14	4·08	4·02	3·96	3·91	3·85	3·80	3·76	3·71	3·67	3·63	3·59	3·55
73	4·63	4·55	4·47	4·40	4·33	4·27	4·21	4·15	4·10	4·04	3·99	3·95	3·90	3·86	3·82	3·78
74	4·93	4·85	4·77	4·69	4·62	4·55	4·49	4·43	4·37	4·31	4·26	4·21	4·16	4·11	4·07	4·03
75	5·28	5·19	5·10	5·02	4·95	4·87	4·80	4·74	4·67	4·61	4·56	4·50	4·45	4·40	4·35	4·31
76	5·67	5·58	5·48	5·40	5·31	5·24	5·16	5·09	5·02	4·96	4·90	4·84	4·78	4·73	4·68	4·63
77	6·13	6·02	5·92	5·83	5·74	5·65	5·57	5·50	5·42	5·35	5·29	5·22	5·16	5·11	5·05	5·00
78	6·65	6·54	6·43	6·33	6·23	6·14	6·05	5·97	5·89	5·82	5·74	5·67	5·61	5·55	5·49	5·43
79	7·28	7·15	7·03	6·92	6·82	6·72	6·62	6·53	6·44	6·36	6·28	6·21	6·13	6·07	6·00	5·94
80	8·02	7·88	7·75	7·63	7·51	7·40	7·30	7·20	7·10	7·01	6·92	6·84	6·76	6·69	6·62	6·55
81	8·93	8·78	8·63	8·50	8·37	8·24	8·12	8·01	7·91	7·80	7·71	7·62	7·53	7·45	7·37	7·29
82	10·1	9·89	9·73	9·57	9·43	9·29	9·16	9·03	8·91	8·80	8·69	8·58	8·48	8·39	8·30	8·22
83	11·5	11·3	11·1	11·0	10·8	10·6	10·5	10·3	10·2	10·1	9·94	9·82	9·71	9·60	9·50	9·40
84	13·5	13·2	13·0	12·8	12·6	12·4	12·2	12·1	11·9	11·8	11·6	11·5	11·3	11·2	11·1	11·0
85	16·2	15·9	15·6	15·4	15·1	14·9	14·7	14·5	14·3	14·1	14·0	13·8	13·6	13·5	13·3	13·2
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	9 Hrs.	8 HOURS.														

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	4 HOURS.															5 Hrs.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 38	m. 40	m. 44	m. 48	m. 52	m. 56	m. 00
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0	·67	·66	·65	·65	·64	·64	·63	·63	·62	·62	·61	·61	·61	·60	·60	·60
30	·69	·69	·68	·67	·67	·66	·66	·65	·65	·64	·64	·64	·63	·63	·63	·62
31	·72	·71	·71	·70	·70	·69	·68	·68	·67	·67	·66	·66	·66	·65	·65	·65
32	·75	·74	·74	·73	·72	·72	·71	·71	·70	·70	·69	·69	·68	·68	·68	·67
33	·78	·77	·76	·76	·75	·74	·74	·73	·73	·72	·72	·71	·71	·71	·70	·70
34	·81	·80	·79	·79	·78	·77	·77	·76	·76	·75	·75	·74	·74	·73	·73	·72
35	·84	·83	·82	·82	·81	·80	·80	·79	·78	·78	·77	·77	·76	·76	·76	·75
36	·87	·86	·85	·85	·84	·83	·82	·82	·81	·81	·80	·80	·79	·79	·78	·78
37	·90	·89	·88	·88	·87	·86	·86	·85	·84	·84	·83	·83	·82	·82	·81	·81
38	·94	·93	·92	·91	·90	·89	·89	·88	·87	·87	·86	·86	·85	·85	·84	·84
39	·97	·96	·95	·94	·93	·93	·92	·91	·90	·90	·89	·89	·88	·88	·87	·87
40	1·00	·99	·98	·98	·97	·96	·95	·94	·94	·93	·93	·92	·91	·91	·90	·90
41	1·04	1·03	1·02	1·01	1·00	·99	·99	·98	·97	·96	·96	·95	·95	·94	·94	·93
42	1·08	1·07	1·06	1·05	1·04	1·03	1·02	1·01	1·01	1·00	·99	·99	·98	·98	·97	·97
43	1·12	1·10	1·09	1·08	1·07	1·07	1·06	1·05	1·04	1·03	1·03	1·02	1·02	1·01	1·00	1·00
44	1·15	1·14	1·13	1·12	1·11	1·10	1·09	1·09	1·08	1·07	1·06	1·06	1·05	1·05	1·04	1·04
45	1·20	1·18	1·17	1·16	1·15	1·14	1·13	1·12	1·12	1·11	1·10	1·10	1·09	1·08	1·08	1·07
46	1·24	1·23	1·21	1·20	1·19	1·18	1·17	1·16	1·16	1·15	1·14	1·13	1·13	1·12	1·12	1·11
47	1·28	1·27	1·26	1·25	1·24	1·23	1·22	1·21	1·20	1·19	1·18	1·17	1·17	1·16	1·16	1·15
48	1·33	1·32	1·30	1·29	1·28	1·27	1·26	1·25	1·24	1·23	1·22	1·22	1·21	1·20	1·20	1·19
49	1·38	1·36	1·35	1·34	1·33	1·31	1·30	1·29	1·29	1·28	1·27	1·26	1·25	1·25	1·24	1·23
50	1·43	1·41	1·40	1·39	1·37	1·36	1·35	1·34	1·33	1·32	1·31	1·31	1·30	1·29	1·28	1·28
51	1·48	1·46	1·45	1·44	1·42	1·41	1·40	1·39	1·38	1·37	1·36	1·35	1·35	1·34	1·33	1·33
52	1·53	1·52	1·50	1·49	1·48	1·46	1·45	1·44	1·43	1·42	1·41	1·40	1·40	1·39	1·38	1·37
53	1·59	1·57	1·56	1·54	1·53	1·52	1·51	1·50	1·48	1·47	1·46	1·46	1·45	1·44	1·43	1·42
54	1·65	1·63	1·62	1·60	1·59	1·58	1·56	1·55	1·54	1·53	1·52	1·51	1·50	1·49	1·49	1·48
55	1·71	1·70	1·68	1·66	1·65	1·64	1·62	1·61	1·60	1·59	1·58	1·57	1·56	1·55	1·54	1·53
56	1·78	1·76	1·74	1·73	1·71	1·70	1·69	1·67	1·66	1·65	1·64	1·63	1·62	1·61	1 60	1·59
57	1·85	1·83	1·81	1·80	1·78	1·77	1·75	1·74	1·73	1·71	1·70	1·69	1·68	1·67	1·66	1·66
58	1·92	1·90	1·88	1·87	1·85	1·84	1·82	1·81	1·79	1·78	1·77	1·76	1·75	1·74	1·73	1·72
59	2·00	1·98	1·96	1·94	1·93	1·91	1·90	1·88	1·87	1·86	1·84	1·83	1·82	1·81	1·80	1·79
60	2·08	2·06	2·04	2·02	2·01	1·99	1·97	1·96	1·95	1·93	1·92	1·91	1·90	1·89	1·88	1·87
61	2·17	2·15	2·13	2·11	2·09	2·08	2·06	2·04	2·03	2·01	2·00	1·99	1·98	1·97	1·96	1·95
62	2·27	2·24	2·22	2·20	2·18	2·17	2·15	2·13	2·12	2·10	2·09	2·08	2·06	2·05	2·04	2·03
63	2·37	2·34	2·32	2·30	2·28	2·26	2·24	2·23	2·21	2·20	2·18	2·17	2·16	2·14	2·13	2·12
64	2·48	2·45	2·43	2·41	2·39	2·37	2·35	2·33	2·31	2·30	2·28	2·27	2·25	2·24	2·23	2·22
65	2·59	2·57	2·54	2·52	2·50	2·48	2·46	2·44	2·42	2·41	2·39	2·38	2·36	2·35	2·34	2·33
66	2·72	2·69	2·67	2·64	2·62	2·60	2·58	2·56	2·54	2·52	2·51	2·49	2·48	2·46	2·45	2·44
67	2·86	2·83	2·80	2·78	2·75	2·73	2·71	2·69	2·67	2·65	2·63	2·62	2·60	2·59	2·57	2·56
68	3·01	2·98	2·95	2·92	2·90	2·87	2·85	2·83	2·81	2·79	2·77	2·76	2·74	2·72	2·71	2·70
69	3·17	3·14	3·11	3·08	3·06	3·03	3·01	2·98	2·96	2·94	2·92	2·91	2·89	2·87	2·86	2·84
70	3·35	3·32	3·29	3·26	3·23	3·20	3·18	3·16	3·13	3·11	3·09	3·07	3·05	3·04	3·02	3·01
71	3·55	3·52	3·49	3·45	3·42	3·40	3·37	3·34	3·32	3·30	3·28	3·26	3·24	3·22	3·20	3·19
72	3·78	3·74	3·70	3·67	3·64	3·61	3·58	3·55	3·53	3·50	3·48	3·46	3·44	3·42	3·40	3·39
73	4·03	3·99	3·95	3·91	3·88	3·85	3·82	3·79	3·76	3·74	3·71	3·69	3·67	3·65	3·63	3·61
74	4·31	4·27	4·23	4·19	4·15	4·12	4·09	4·05	4·03	4·00	3·97	3·95	3·92	3·90	3·88	3·86
75	4·63	4·59	4·54	4·50	4·46	4·43	4·39	4·36	4·33	4·30	4·27	4·24	4·22	4·19	4·17	4·15
76	5·00	4·95	4·91	4·86	4·82	4·78	4·74	4·71	4·67	4·64	4·61	4·58	4·55	4·53	4·51	4·48
77	5·43	5·38	5·33	5·28	5·23	5·19	5·15	5·11	5·07	5·04	5·01	4·98	4·95	4·92	4·89	4·87
78	5·94	5·88	5·83	5·77	5·72	5·68	5·63	5·59	5·55	5·51	5·47	5·44	5·41	5·38	5·35	5·33
79	6·55	6·48	6·42	6·37	6·31	6·26	6·21	6·16	6·12	6·07	6·04	6·00	5·96	5·93	5·90	5·87
80	7·29	7·22	7·15	7·09	7·02	6·97	6·91	6·86	6·81	6·76	6·72	6·68	6·64	6·60	6·57	6·54
81	8·22	8·14	8·06	7·99	7·92	7·85	7·79	7·73	7·67	7·62	7·57	7·53	7·48	7·44	7·40	7·37
82	9·40	9·31	9·22	9·14	9·06	8·99	8·92	8·85	8·78	8·72	8·67	8·61	8·56	8·52	8·47	8·43
83	11·0	10·9	10·8	10·7	10·6	10·5	10·4	10·3	10·3	10·2	10·1	10·1	10·0	9·95	9·90	9·85
84	13·2	13·1	12·9	12·8	12·7	12·6	12·5	12·4	12·3	12·2	12·2	12·1	12·0	12·0	11·9	11·8
85																
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	8 Hrs.	7 HOURS.														

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination	5 HOURS.															6 Hrs.
	m. 00	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 46	m. 52	m. 56	m. 00
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
30	·60	·60	·59	·59	·59	·59	·58	·58	·58	·58	·58	·58	·58	·58	·58	·58
31	·62	·62	·62	·61	·61	·61	·61	·61	·61	·60	·60	·60	·60	·60	·60	·60
32	·65	·64	·64	·64	·64	·63	·63	·63	·63	·63	·63	·63	·63	·63	·62	·62
33	·67	·67	·67	·66	·66	·66	·66	·66	·65	·65	·65	·65	·65	·65	·65	·65
34	·70	·70	·69	·69	·69	·68	·68	·68	·68	·68	·68	·68	·68	·67	·67	·67
35	·72	·72	·72	·72	·71	·71	·71	·71	·71	·70	·70	·70	·70	·70	·70	·70
36	·75	·75	·75	·74	·74	·74	·74	·73	·73	·73	·73	·73	·73	·73	·73	·73
37	·78	·78	·77	·77	·77	·77	·76	·76	·76	·76	·76	·76	·75	·75	·75	·75
38	·81	·81	·80	·80	·80	·79	·79	·79	·79	·79	·78	·78	·78	·78	·78	·78
39	·84	·83	·83	·83	·82	·82	·82	·82	·82	·81	·81	·81	·81	·81	·81	·81
40	·87	·86	·86	·86	·85	·85	·85	·85	·85	·84	·84	·84	·84	·84	·84	·84
41	·90	·90	·89	·89	·89	·88	·88	·88	·88	·87	·87	·87	·87	·87	·87	·87
42	·93	·93	·92	·92	·92	·91	·91	·91	·91	·91	·90	·90	·90	·90	·90	·90
43	·97	·96	·96	·95	·95	·95	·94	·94	·94	·94	·94	·93	·93	·93	·93	·93
44	1·00	1·00	·99	·99	·98	·98	·98	·98	·97	·97	·97	·97	·97	·97	·97	·97
45	1·04	1·03	1·03	1·02	1·02	1·02	1·01	1·01	1·01	1·01	1·00	1·00	1·00	1·00	1·00	1·00
46	1·07	1·07	1·06	1·06	1·05	1·05	1·05	1·05	1·04	1·04	1·04	1·04	1·04	1·04	1·04	1·04
47	1·11	1·11	1·10	1·10	1·09	1·09	1·09	1·08	1·08	1·08	1·08	1·07	1·07	1·07	1·07	1·07
48	1·15	1·14	1·14	1·14	1·13	1·13	1·12	1·12	1·12	1·12	1·11	1·11	1·11	1·11	1·11	1·11
49	1·19	1·19	1·18	1·18	1·17	1·17	1·16	1·16	1·16	1·16	1·15	1·15	1·15	1·15	1·15	1·15
50	1·23	1·23	1·22	1·22	1·21	1·21	1·21	1·20	1·20	1·20	1·20	1·19	1·19	1·19	1·19	1·19
51	1·28	1·27	1·27	1·26	1·26	1·25	1·25	1·25	1·24	1·24	1·24	1·24	1·24	1·24	1·24	1·23
52	1·33	1·32	1·31	1·31	1·30	1·30	1·30	1·29	1·29	1·29	1·28	1·28	1·28	1·28	1·28	1·28
53	1·37	1·37	1·36	1·36	1·35	1·35	1·34	1·34	1·34	1·33	1·33	1·33	1·33	1·33	1·33	1·33
54	1·42	1·42	1·41	1·41	1·40	1·40	1·39	1·39	1·39	1·38	1·38	1·38	1·38	1·38	1·38	1·38
55	1·48	1·47	1·47	1·46	1·45	1·45	1·45	1·44	1·44	1·44	1·43	1·43	1·43	1·43	1·43	1·43
56	1·53	1·53	1·52	1·52	1·51	1·51	1·50	1·50	1·49	1·49	1·49	1·49	1·48	1·48	1·48	1·48
57	1·59	1·59	1·58	1·57	1·57	1·56	1·56	1·55	1·55	1·55	1·55	1·54	1·54	1·54	1·54	1·54
58	1·66	1·65	1·64	1·64	1·63	1·63	1·62	1·62	1·61	1·61	1·61	1·60	1·60	1·60	1·60	1·60
59	1·72	1·72	1·71	1·70	1·70	1·69	1·69	1·68	1·68	1·67	1·67	1·67	1·67	1·67	1·66	1·66
60	1·79	1·79	1·78	1·77	1·76	1·76	1·75	1·75	1·75	1·74	1·74	1·74	1·73	1·73	1·73	1·73
61	1·87	1·86	1·85	1·84	1·84	1·83	1·83	1·82	1·82	1·81	1·81	1·81	1·81	1·81	1·80	1·80
62	1·95	1·94	1·93	1·92	1·92	1·91	1·90	1·90	1·89	1·89	1·89	1·89	1·88	1·88	1·88	1·88
63	2·03	2·02	2·01	2·01	2.00	1·99	1·99	1·98	1·98	1·97	1·97	1·97	1·97	1·96	1·96	1·96
64	2·12	2·11	2·10	2·10	2·09	2·08	2·08	2·07	2·07	2·06	2·06	2·06	2·05	2·05	2·05	2·05
65	2·22	2·21	2·20	2·19	2·18	2·18	2·17	2·17	2·16	2·16	2·15	2·15	2·15	2·15	2·14	2·14
66	2·33	2·31	2·31	2·30	2·29	2·28	2·27	2·27	2·26	2·26	2·25	2·25	2·25	2·25	2·25	2·25
67	2·44	2·43	2·42	2·41	2·40	2·39	2·39	2·38	2·37	2·37	2·36	2·36	2·36	2·36	2·36	2·36
68	2·56	2·55	2·54	2·53	2·52	2·51	2·51	2·50	2·49	2·49	2·48	2·48	2·48	2·48	2·48	2·48
69	2·70	2·68	2·67	2·66	2·65	2·65	2·64	2·63	2·62	2·62	2·62	2·61	2·61	2·61	2·61	2·61
70	2·84	2·83	2·82	2·81	2·80	2·79	2·78	2·77	2·77	2·76	2·76	2·75	2·75	2·75	2·75	2·75
71	3·01	2·99	2·98	2·97	2·96	2·95	2·94	2·93	2·93	2·92	2·92	2·91	2·91	2·91	2·90	2·90
72	3·19	3·17	3·16	3·15	3·14	3·13	3·12	3·11	3·10	3·09	3·09	3·09	3·08	3·08	3·08	3·08
73	3·39	3·37	3·36	3·34	3·33	3·32	3·31	3·30	3·30	3·29	3·28	3·28	3·28	3·27	3·27	3·27
74	3·61	3·59	3·58	3·57	3·55	3·54	3·53	3·52	3·51	3·51	3·50	3·50	3·49	3·49	3·49	3·49
75	3·86	3·85	3·83	3·82	3·80	3·79	3·78	3·77	3·76	3·75	3·75	3·74	3·74	3·73	3·73	3·73
76	4·15	4·13	4·12	4·10	4·09	4·07	4·06	4·05	4·04	4·03	4·03	4·02	4·02	4·01	4·01	4·01
77	4·48	4·46	4·45	4·43	4·41	4·40	4·39	4·37	4·36	4·36	4·35	4·34	4·34	4·33	4·33	4·33
78	4·87	4·85	4·83	4·81	4·79	4·78	4·76	4·75	4·74	4·73	4·72	4·72	4·71	4·71	4·71	4·70
79	5·33	5·30	5·28	5·26	5·24	5·22	5·21	5·20	5·18	5·17	5·16	5·16	5·15	5·15	5·15	5·14
80	5·87	5·84	5·82	5·80	5·78	5·76	5·74	5·73	5·71	5·70	5·69	5·69	5·68	5·67	5·67	5·67
81	6·54	6·51	6·48	6·45	6·43	6·41	6·39	6·38	6·36	6·35	6·34	6·33	6·32	6·32	6·31	6·31
82	7·37	7·33	7·30	7·27	7·25	7·23	7·20	7·19	7·17	7·15	7·14	7·13	7·13	7·12	7·12	7·12
83	8·43	8·39	8·36	8·33	8·30	8·27	8·25	8·22	8·21	8·19	8·18	8·16	8·16	8·15	8·15	8·14
84	9·85	9·81	9·76	9·73	9·69	9·66	9·63	9·61	9·59	9·57	9·55	9·54	9·53	9·52	9·52	9·51
85	11·83	11·78	11·73	11·69	11·64	11·61	11·57	11·54	11·52	11·49	11·47	11·46	11·45	11·44	11·43	11·43
	m. 00	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 00
	7 Hrs.	6 HOURS.														

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	0 HOUR.															
	m. 1	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	2620	655	327	218	163	131	109	93·1	81·3	72·2	64·8	58·8	53·8	49·5	45·8	42·7
85½	2912	728	364	243	182	145	121	104	90·4	80·2	72·1	65·4	59·8	55·0	51·0	47·4
86	3277	819	410	273	205	164	136	117	102	90·3	81·1	73·6	67·3	62·0	57·4	53·4
86½	3747	937	468	312	234	187	156	133	116	103	92·7	84·1	76·9	70·8	65·6	61·0
87	4373	1093	546	364	273	218	182	155	136	121	108	98·2	89·8	82·6	76·5	71·2
87½	5259	1312	656	437	328	262	218	187	163	145	130	118	108	99·2	91·9	85·5
88	6563	1641	820	546	410	327	273	233	204	181	162	147	135	124	115	107
88½	8752	2188	1094	729	546	436	363	311	272	241	217	196	180	165	153	143
89	13129	3282	1641	1093	819	655	545	467	408	362	325	295	270	248	230	214
89½	26261	6565	3281	2186	1639	1310	1090	933	815	723	650	590	539	496	460	428
	m. 59	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	11 HOURS.															

Lat.	1 HOUR.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	42·7	39·9	37·4	35·2	33·2	31·4	29·8	28·3	26·9	25·7	24·5	23·4	22·4	21·5	20·6	19·8
85½	47·4	44·3	41·6	39·1	36·9	34·9	33·1	31·4	29·9	28·5	27·2	26·1	24·9	23·9	22·9	22·0
86	53·4	49·9	46·8	44·0	41·5	39·3	37·3	35·4	33·7	32·1	30·7	29·3	28·1	26·9	25·8	24·8
86½	61·0	57·0	53·5	50·3	47·5	44·9	42·6	40·5	38·5	36·7	35·1	33·5	32·1	30·7	29·5	28·3
87	71·2	66·5	62·4	58·7	55·4	52·4	49·7	47·2	45·0	42·9	40·9	39·1	37·4	35·9	34·4	33·0
87½	85·5	79·9	74·9	70·5	66·5	62·9	59·7	56·7	54·0	51·4	49·1	47·0	45·0	43·1	41·3	39·7
88	107	99·9	93·7	88·1	83·2	78·7	74·6	70·9	67·5	64·3	61·4	58·7	56·2	53·9	51·7	49·6
88½	143	133	125	118	111	105	99·5	94·5	90·0	85·8	81·9	78·3	74·9	71·8	68·9	66·1
89	214	200	187	176	166	157	149	142	135	129	123	117	112	108	103	99·2
89½	428	400	375	353	333	315	299	284	270	257	246	235	225	216	207	198
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	10 HOURS.															

Lat.	2 HOURS.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	19·8	19·0	18·3	17·6	16·9	16·3	15·7	15·2	14·6	14·1	13·6	13·1	12·7	12·3	11·8	11·4
85½	22·0	21·1	20·3	19·6	18·8	18·2	17·5	16 9	16·3	15·7	15·1	14·6	14·1	13·6	13·2	12·7
86	24·8	23·8	22·9	22·0	21·2	20·4	19·7	19·0	18·3	17·7	17·0	16·5	15·9	15·3	14·8	14·3
86½	28·3	27·2	26·2	25·2	24·2	23·4	22·5	21·7	20·9	20·2	19·5	18·8	18·2	17·5	16·9	16·3
87	33·0	31·8	30·5	29·4	28·3	27·3	26·3	25·3	24·4	23·6	22·7	22·0	21·2	20·5	19·8	19·1
87½	39·7	38·1	36·7	35·3	34·0	32·7	31·5	30·4	29·3	28·3	27·3	26·3	25·4	24·6	23·7	22·9
88	49·6	47·7	45·8	44·1	42·5	40·9	39·4	38·0	36·7	35·4	34·1	32·9	31·8	30·7	29·7	28·6
88½	66·1	63·6	61·1	58·8	56·6	54·5	52·6	50·7	48·9	47·2	45·5	43·9	42·4	41·0	39·5	38·2
89	99·2	95·3	91·7	88·2	84·9	81·8	78·9	76·0	73·3	70·7	68·3	65·9	63·6	61·4	59·3	57·3
89½	198	191	183	176	170	164	158	152	147	142	137	132	127	123	119	115
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	9 HOURS.															

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

Declination.	0 HOURS.															
	m. 1	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
85°	2620	655	328	218	164	131	109	93·8	82·1	73·1	65·8	59·9	55·0	50·8	47·2	44·2
85½	2912	728	364	243	182	146	122	104	91·3	81·2	73·2	66·6	61·1	56·5	52·5	49·1
86	3277	819	410	273	205	164	137	117	103	91·4	82·4	74·9	68·8	63·6	59·1	55·3
86½	3747	937	468	312	234	188	156	134	117	105	94·2	85·7	78·6	72·7	67·6	63·2
87	4373	1093	547	365	274	219	183	157	137	122	110	100	91·8	84·8	78·9	73·7
87½	5259	1312	656	438	328	263	219	188	165	146	132	120	110	102	94·7	88·5
88	6563	1641	821	547	411	329	274	235	206	183	165	150	138	127	118	111
88½	8752	2188	1094	730	547	438	365	313	274	244	220	200	184	170	158	148
89	13129	3283	1642	1095	821	657	548	470	412	366	330	300	276	255	237	221
89½	26261	6566	3283	2190	1643	1315	1096	940	823	733	660	601	551	509	474	443
	m. 59	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	11 HOURS.															

Declination.	1 HOUR.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
85°	44·2	41·5	39·1	37·0	35·1	33·4	31·9	30·5	29·3	28·1	27·0	26·1	25·2	24·3	23·6	22·9
85½	49·1	46·1	43·5	41·1	39·0	37·2	35·5	33·9	32·5	31·2	30·1	29·0	28·0	27·1	26·2	25·4
86	55·3	51·9	48·9	46·3	43·9	41·8	39·9	38·2	36·6	35·2	33·8	32·6	31·5	30·5	29·5	28·6
86½	63·2	59·3	55·9	52·9	50·2	47·8	45·6	43·6	41·8	40·2	38·7	37·3	36·0	34·8	33·7	32·7
87	73·7	69·2	65·3	61·7	58·6	55·8	53·2	50·9	48·8	46·9	45·1	43·5	42·0	40·6	39·4	38·2
87½	88·5	83·1	78·3	74·1	70·4	67·0	63·9	61·1	58·6	56·3	54·2	52·2	50·4	48·8	47·2	45·8
88	111	104	97·9	92·7	88·0	83·7	79·9	76·4	73·3	70·4	67·8	65·3	63·1	61·0	59·1	57·3
88½	148	139	131	124	117	112	107	102	97·7	93·9	90·4	87·1	84·1	81·3	78·8	76·4
89	221	208	196	185	176	168	160	153	147	141	136	131	126	122	118	115
89½	443	416	392	371	352	335	320	306	293	282	271	261	252	244	236	229
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	10 HOURS.															

Declination.	2 HOURS.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
85°	22·9	22·2	21·6	21·0	20·4	19·9	19·4	19·0	18·6	18·2	17·8	17·4	17·1	16·8	16·5	16·2
85½	25·4	24·7	24·0	23·3	22·7	22·2	21·6	21·1	20·6	20·2	19·8	19·4	19·0	18·6	18·3	18·0
86	28·6	27·8	27·0	26·3	25·6	24·9	24·3	23·8	23·2	22·7	22·2	21·8	21·4	21·0	20·6	20·2
86½	32·7	31·7	30·9	30·0	29·2	28·5	27·8	27·2	26·6	26·0	25·4	24·9	24·4	24·0	23·5	23·1
87	38·2	37·0	36·0	35·0	34·1	33·3	32·5	31·7	31·0	30·3	29·7	29·1	28·5	28·0	27·5	27·0
87½	45·8	44·5	43·2	42·1	41·0	39·9	39·0	38·1	37·2	36·4	35·6	34·9	34·2	33·6	33·0	32·4
88	57·3	55·6	54·0	52·6	51·2	49·9	48·7	47·6	46·5	45·5	44·6	43·6	42·8	42·0	41·2	40·5
88½	76·4	74·1	72·1	70·1	68·3	66·6	65·0	63·5	62·0	60·7	59·4	58·2	57·1	56·0	55·0	54·0
89	115	111	108	105	102	99·9	97·5	95·2	93·1	91·0	89·1	87·3	85·6	84·0	82·5	81·0
89½	229	222	216	210	205	200	195	190	186	182	178	175	171	168	165	162
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	9 HOURS.															

Table A.

When hour angle is less than 6 hours, name the factors taken from Table A *contrary* to name of lat.

Lat.	3 HOURS.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	11·4	11·0	10·7	10·3	9·9	9·6	9·3	8·9	8·6	8·3	8·0	7·7	7·4	7·1	6·9	6·6
85½	12·7	12·3	11·8	11·4	11·1	10·7	10·3	9·9	9·6	9·2	8·9	8·6	8·3	7·9	7·6	7·3
86	14·3	13·8	13·3	12·9	12·4	12·0	11·6	11·2	10·8	10·4	10·0	9·7	9·3	8·9	8·6	8·3
86½	16·3	15·8	15·2	14·7	14·2	13·7	13·2	12·8	12·3	11·9	11·4	11·0	10·6	10·2	9·8	9·4
87	19·1	18·4	17·8	17·2	16·6	16·0	15·5	14·9	14·4	13·9	13·4	12·9	12·4	11·9	11·5	11·0
87½	22·9	22·1	21·4	20·6	19·9	19·2	18·5	17·9	17·3	16·6	16·0	15·4	14·9	14·3	13·8	13·2
88	28·6	27·7	26·7	25·8	24·9	24·0	23·2	22·4	21·6	20·8	20·1	19·3	18·6	17·9	17·2	16·5
88½	38·2	36·9	35·6	34·4	33·2	32·0	30·9	29·8	28·8	27·7	26·7	25·8	24·8	23·9	23·0	22·1
89	57·3	55·3	53·4	51·6	49·8	48·1	46·4	44·8	43·2	41·6	40·1	38·6	37·2	35·8	34·4	33·1
89½	115	111	107	103	99·6	96·2	92·8	89·5	86·3	83·3	80·2	77·3	74·4	71·6	68·9	66·2
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	8 HOURS.															

Lat.	4 HOURS.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	6·60	6·34	6·08	5·82	5·57	5·33	5·09	4·85	4·62	4·39	4·16	3·94	3·71	3·49	3·28	3·06
85½	7·34	7·04	6·76	6·47	6·20	5·93	5·66	5·39	5·13	4·88	4·62	4·38	4·13	3·88	3·64	3·40
86	8·26	7·93	7·60	7·29	6·97	6·67	6·37	6·07	5·78	5·49	5·21	4·92	4·65	4·37	4·10	3·83
86½	9·44	9·06	8·69	8·33	7·97	7·62	7·28	6·94	6·61	6·28	5·95	5·63	5·31	5·00	4·69	4·38
87	11·0	10·6	10·1	9·72	9·31	8·90	8·50	8·10	7·71	7·32	6·94	6·57	6·20	5·83	5·47	5·11
87½	13·2	12·7	12·2	11·7	11·2	10·7	10·2	9·72	9·25	8·79	8·34	7·89	7·44	7·00	6·57	6·14
88	16·5	15·9	15·2	14·6	14·0	13·4	12·7	12·2	11·6	11·0	10·4	9·86	9·30	8·76	8·21	7·67
88½	22·1	21·2	20·3	19·5	18·6	17·8	17·0	16·2	15·4	14·7	13·9	13·1	12·4	11·7	11·0	10·2
89	33·1	31·8	30·5	29·2	27·9	26·7	25·5	24·3	23·2	22·0	20·9	19·7	18·6	17·5	16·4	15·4
89½	66·2	63·5	60·9	58·4	55·9	53·4	51·0	48·6	46·3	44·0	41·7	39·5	37·2	35·0	32·9	30·7
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	7 HOURS.															

Lat.	5 HOURS.															
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	3·06	2·85	2·64	2·43	2·22	2·02	1·81	1·61	1·40	1·20	1·00	0·80	0·60	0·40	0·20	·00
85½	3·40	3·17	2·93	2·70	2·47	2·24	2·01	1·79	1·56	1·34	1·11	0·89	0·67	0·44	0·22	·00
86	3·83	3·57	3·30	3·04	2·78	2·52	2·27	2·01	1·76	1·50	1·25	1·00	0·75	0·50	0·25	·00
86½	4·38	4·08	3·77	3·48	3·18	2·88	2·59	2·30	2·01	1·78	1·43	1·14	0·86	0·57	0·29	·00
87	5·11	4·76	4·41	4·06	3·71	3·36	3·02	2·68	2 34	2·01	1·67	1·33	1·00	0·67	0·33	·00
87½	6·14	5·71	5·29	4·87	4·45	4·04	3·63	3·22	2·81	2·41	2·00	1·60	1·20	0·80	0·40	·00
88	7·67	7·14	6·61	6·09	5·57	5·05	4·54	4·05	3·52	3·01	2·51	2·00	1·50	1·00	0·50	·00
88½	10·2	9·52	8·82	8·12	7·42	6·73	6·05	5·37	4 69	4·01	3·34	2·67	2·00	1·33	0·67	·00
89	15·4	14·3	13·2	12·2	11·1	10·1	9·07	8·05	7·03	6·02	5·01	4·01	3·00	2·00	1·00	·00
89½	30·7	28·6	26·5	24·4	22·3	20·2	18·1	16·1	14·1	12·0	10·0	8·01	6·01	4·00	2·00	·00
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0
	6 HOURS.															

When hour angle is more than 6 hours, name the factors taken from Table A the *same* as the name of the latitude.

Table B.

Always name the factors taken from Table B the *same* as the name of declination.

3 HOURS.

Declination.	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	16·2	15·9	15·6	15·4	15·1	14·9	14·7	14·5	14·3	14·1	14·0	13·8	13·6	13·5	13·3	13·2
85½	18·0	17·7	17·4	17·1	16·8	16·6	16·3	16·1	15·9	15·7	15·5	15·3	15·2	15·0	14·8	14·7
86	20·2	19·9	19·6	19·2	18·9	18·7	18·4	18·1	17·9	17·7	17·5	17·2	17·1	16·9	16·7	16·5
86½	23·1	22·7	22·4	22·0	21·7	21·3	21·0	20·7	20·5	20·2	20·0	19·7	19·5	19·3	19·1	18·9
87	27·0	26·5	26·1	25·7	25·3	24·9	24·6	24·2	23·9	23·6	23·3	23·0	22·8	22·5	22·3	22·0
87½	32·4	31·8	31·3	30·8	30·3	29·9	29·5	29·1	28·7	28·3	28·0	27·6	27·3	27·0	26·7	26·4
88	40·5	39·8	39·2	38·5	37·9	37·4	36·8	36·3	35·9	35·4	35·0	34·5	34·1	33·8	33·4	33·1
88½	54·0	53·1	52·2	51·4	50·6	49·9	49·1	48·5	47·8	47·2	46·6	46·1	45·5	45·0	44·6	44·1
89	81·0	79·6	78·3	77·1	75·9	74·8	73·7	72·7	71·7	70·8	69·9	69·1	68·3	67·6	66·8	66·2
89½	162	159	157	154	152	150	147	145	143	142	140	138	137	135	134	132
	m. 60	m. 56	m. 52	m. 48	m. 44	m. 40	m. 36	m. 32	m. 28	m. 24	m. 20	m. 16	m. 12	m. 8	m. 4	m. 0

8 HOURS.

4 HOURS.

Declination.	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	13·2	13·1	12·9	12·8	12·7	12·6	12·5	12·4	12·3	12·2	12·2	12·1	12·0	12·0	11·9	11·8
85½	14·7	14·5	14·4	14·3	14·1	14·0	13·9	13·8	13·7	13·6	13·5	13·4	13·4	13·3	13·2	13·2
86	16·5	16·4	16·2	16·1	15·9	15·8	15·7	15·5	15·4	15·3	15·2	15·1	15·0	15·0	14·9	14·8
86½	18·0	18·7	18·5	18·3	18·2	18·0	17·9	17·8	17·6	17·5	17·4	17·3	17·2	17·1	17·0	16·9
87	22·0	21·8	21·6	21·4	21·2	21·1	20·9	20·7	20·6	20·4	20·3	20·2	20·1	20·0	19·9	19·8
87½	26·4	26·2	25·9	25·7	25·5	25·3	25·1	24·9	24·7	24·5	24·4	24·2	24·1	24·0	23·8	23·7
88	33·1	32·7	32·4	32·1	31·9	31·6	31·3	31·1	30·9	30·7	30·5	30·3	30·1	29·9	29·8	29·6
88½	44·1	43·7	43·3	42·9	42·5	42·1	41·8	41·5	41·2	40·9	40·6	40·4	40·2	39·9	39·7	39·5
89	66·2	65·5	64·9	64·3	63·7	63·2	62·7	62·2	61·8	61·4	61·0	60·6	60·2	59·9	59·6	59·3
89½	132	131	130	129	127	126	125	124	124	123	122	121	120	120	119	119
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60

7 HOURS.

5 HOURS.

Declination.	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
85	11·8	11·8	11·7	11·7	11·6	11·6	11·6	11·5	11·5	11·5	11·5	11·5	11·5	11·4	11·4	11·4
85½	13·2	13·1	13·0	13·0	13·0	12·9	12·9	12·8	12·8	12·8	12·8	12·7	12·7	12·7	12·7	12·7
86	14·8	14·7	14·7	14·6	14·6	14·5	14·5	14·4	14·4	14·4	14·4	14·3	14·3	14·3	14·3	14·3
86½	16·9	16·8	16·8	16·7	16·7	16·6	16·6	16·5	16·5	16·4	16·4	16·4	16·4	16·4	16·4	16·3
87	19·8	19·7	19·6	19·5	19·4	19·4	19·3	19·3	19·2	19·2	19·2	19·1	19·1	19·1	19·1	19·1
87½	23·7	23·6	23·5	23·4	23·3	23·3	23·2	23·1	23·1	23·0	23·0	23·0	22·9	22·9	22·9	22·9
88	29·6	29·5	29·4	29·3	29·2	29·1	29·0	28·9	28·9	28·8	28·7	28·7	28·7	28·7	28·6	28·6
88½	39·5	39·4	39·2	39·0	38·9	38·8	38·7	38·6	38·5	38·4	38·3	38·3	38·2	38·2	38·2	38·2
89	59·3	59·0	58·8	58·6	58·4	58·2	58·0	57·9	57·7	57·6	57·5	57·4	57·4	57·3	57·3	57·3
89½	119	118	118	117	117	116	116	116	115	115	115	115	115	115	115	115
	m. 0	m. 4	m. 8	m. 12	m. 16	m. 20	m. 24	m. 28	m. 32	m. 36	m. 40	m. 44	m. 48	m. 52	m. 56	m. 60

6 HOURS.

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	00°	5°	10°	13°	16°	18°	20°	22°	24°	25°	26°	27°	28°	29°	30°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·000	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0
·010	89·4	89·4	89·4	89·4	89·4	89·5	89·5	89·5	89·5	89·5	89·5	89·5	89·5	89·5	89·5
·020	88·9	88·9	88·9	88·9	88·9	88·9	88·9	88·9	89·0	89·0	89·0	89·0	89·0	89·0	89·0
·030	88·3	88·3	88·3	88·3	88·3	88·4	88·4	88·4	88·4	88·4	88·5	88·5	88·5	88·5	88·5
·040	87·7	87·7	87·7	87·8	87·8	87·8	87·8	87·9	87·9	87·9	87·9	88·0	88·0	88·0	88·0
·050	87·1	87·1	87·2	87·2	87·2	87·3	87·3	87·3	87·4	87·4	87·4	87·4	87·5	87·5	87·5
·060	86·6	86·6	86·6	86·7	86·7	86·7	86·8	86·8	86·9	86·9	86·9	86·9	87·0	87·0	87·0
·070	86·0	86·0	86·1	86·1	86·2	86·2	86·2	86·3	86·3	86·4	86·4	86·4	86·5	86·5	86·5
·080	85·4	85·4	85·5	85·5	85·6	85·6	85·7	85·8	85·8	85·9	85·9	85·9	86·0	86·0	86·0
·090	84·9	84·9	84·9	85·0	85·1	85·1	85·2	85·2	85·3	85·3	85·4	85·4	85·5	85·5	85·5
·100	84·3	84·3	84·4	84·4	84·5	84·5	84·6	84·7	84·8	84·8	84·9	84·9	85·0	85·0	85·1
·110	83·7	83·7	83·8	83·9	84·0	84·0	84·1	84·2	84·3	84·3	84·4	84·4	84·5	84·5	84·6
·120	83·2	83·2	83·3	83·3	83·4	83·5	83·6	83·7	83·7	83·8	83·8	83·9	84·0	84·0	84·1
·130	82·6	82·6	82·7	82·8	82·9	83·0	83·0	83·1	83·2	83·3	83·3	83·4	83·5	83·5	83·6
·140	82·0	82·1	82·1	82·2	82·3	82·4	82·5	82·6	82·7	82·8	82·8	82·9	83·0	83·0	83·1
·150	81·5	81·5	81·6	81·7	81·8	81·9	82·0	82·1	82·2	82·3	82·3	82·4	82·5	82·5	82·6
·160	80·9	80·9	81·0	81·1	81·3	81·3	81·4	81·6	81·7	81·7	81·8	81·9	82·0	82·0	82·1
·170	80·4	80·4	80·5	80·6	80·7	80·8	80·9	81·0	81·2	81·2	81·3	81·4	81·5	81·5	81·6
·180	79·8	79·8	79·9	80·1	80·2	80·3	80·4	80·5	80·7	80·7	80·8	80·9	81·0	81·1	81·1
·190	79·2	79·3	79·4	79·5	79·6	79·8	79·9	80·0	80·2	80·2	80·3	80·4	80·5	80·6	80·7
·200	78·7	78·7	78·9	79·0	79·1	79·2	79·4	79·5	79·6	79·7	79·8	79·9	80·0	80·1	80·2
·210	78·1	78·2	78·3	78·4	78·6	78·7	78·8	79·0	79·1	79·2	79·3	79·4	79·5	79·6	79·7
·220	77·6	77·6	77·8	77·9	78·1	78·2	78·3	78·5	78·6	78·7	78·8	78·9	79·0	79·1	79·2
·230	77·0	77·1	77·2	77·4	77·5	77·7	77·8	78·0	78·1	78·2	78·3	78·4	78·5	78·6	78·7
·240	76·5	76·6	76·7	76·8	77·0	77·1	77·3	77·5	77·6	77·7	77·8	77·9	78·0	78·1	78·3
·250	76·0	76·0	76·2	76·3	76·5	76·6	76·8	76·9	77·1	77·2	77·3	77·4	77·6	77·7	77·8
·260	75·4	75·5	75·6	75·8	76·0	76·1	76·3	76·4	76·6	76·7	76·8	77·0	77·1	77·2	77·3
·270	74·9	74·9	75·1	75·3	75·5	75·6	75·8	75·9	76·1	76·2	76·4	76·5	76·6	76·7	76·8
·280	74·4	74·4	74·6	74·7	74·9	75·1	75·3	75·4	75·7	75·8	75·9	76·0	76·1	76·2	76·4
·290	73·8	73·9	74·1	74·2	74·4	74·6	74·8	75·0	75·2	75·3	75·4	75·5	75·6	75·8	75·9
·300	73·3	73·4	73·5	73·7	73·9	74·1	74·3	74·5	74·7	74·8	74·9	75·0	75·2	75·3	75·4
·310	72·8	72·8	73·0	73·2	73·4	73·6	73·8	74·0	74·2	74·3	74·4	74·6	74·7	74·8	75·0
·320	72·3	72·3	72·5	72·7	72·9	73·1	73·3	73·5	73·7	73·8	74·0	74·1	74·2	74·4	74·5
·330	71·7	71·8	72·0	72·2	72·4	72·6	72·8	73·0	73 2	73·3	73·5	73·6	73·8	73·9	74·1
·340	71·2	71·3	71·5	71·7	71·9	72·1	72·3	72·5	72·7	72·9	73·0	73·1	73·3	73·4	73·6
·350	70·7	70·8	71·0	71·2	71·4	71·6	71·8	72·0	72·3	72·4	72·5	72·7	72·8	73·0	73·1
·360	70·2	70·3	70·5	70·7	70·9	71·1	71·3	71·5	71·8	71·9	72·1	72·2	72·4	72·5	72·7
·370	69·7	69·8	70·0	70·2	70·4	70·6	70·8	71·1	71·3	71·5	71·6	71·8	71·9	72·1	72·2
·380	69·2	69·3	69·5	69·7	69·9	70·1	70·3	70·6	70·9	71·0	71·1	71·3	71·5	71·6	71·8
·390	68·7	68·8	69·0	69·2	69·4	69·6	69·9	70·1	70·4	70·5	70·7	70·8	71·0	71·2	71·3
·400	68·2	68·3	68·5	68·7	69·0	69·2	69·4	69·7	69·9	70·1	70·2	70·4	70 5	70·7	70·9
·410	67·7	67·8	68·0	68·2	68·5	68·7	68·9	69·2	69·5	69·6	69·8	69·9	70·1	70·3	70·5
·420	67·2	67·3	67·5	67·7	68·0	68·2	68·5	68·7	69·0	69·2	69·3	69·5	69·7	69·8	70·0
·430	66·7	66·8	67·0	67·3	67·5	67·8	68·0	68·3	68·6	68·7	68·9	69·0	69·2	69·4	69·6
·440	66·3	66·3	66·6	66·8	67·1	67·3	67·5	67·8	68·1	68·3	68·4	68·6	68·8	69·0	69·1
·450	65·8	65·9	66·1	66·3	66·6	66·8	67·1	67·4	67·7	67·8	68·0	68·2	68·3	68·5	68·7
·460	65·3	65·4	65·6	65·9	66·1	66·4	66·6	66·9	67·2	67·4	67·5	67·7	67·9	68·1	68·3
·470	64·8	64·9	65·2	65·4	65·7	65·9	66·2	66·5	66·8	66·9	67·1	67·3	67·5	67·7	67·9
·480	64·4	64·4	64·7	64·9	65·2	65·5	65·7	66·0	66·3	66·5	66·7	66·8	67·0	67·2	67·4
·490	63·9	64·0	64·2	64·5	64·8	65·0	65·3	65·6	65·9	66·1	66·2	66·4	66·6	66·8	67·0

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	00°	5°	10°	13°	16°	18°	20°	22°	24°	25°	26°	27°	28°	29°	30°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·500	63·4	63·5	63·8	64·0	64·3	64·6	64·8	65·1	65·5	65·6	65·8	66·0	66·2	66·4	66·6
·510	63·0	63·1	63·3	63·6	63·9	64·1	64·4	64·7	65·0	65·2	65·4	65·6	65·8	66·0	66·2
·520	62·5	62·6	62·9	63·1	63·4	63·7	64·0	64·3	64·6	64·8	64·9	65·1	65·3	65·5	65·8
·530	62·1	62·2	62·4	62·7	63·0	63·2	63·5	63·8	64·2	64·3	64·5	64·7	64·9	65·1	65·3
·540	61·6	61·7	62·0	62·2	62·6	62·8	63·1	63·4	63·7	63·9	64·1	64·3	64·5	64·7	64·9
·550	61·2	61·3	61·6	61·8	62·1	62·4	62·7	63·0	63·3	63·5	63·7	63·9	64·1	64·3	64·5
·560	60·8	60·8	61·1	61·4	61·7	62·0	62·2	62·6	62·9	63·1	63·3	63·5	63·7	63·9	64·1
·570	60·3	60·4	60·7	61·0	61·3	61·5	61·8	62·1	62·5	62·7	62·9	63·1	63·3	63·5	63·7
·580	59·9	60·0	60·3	60·5	60·9	61·1	61·4	61·7	62·1	62·3	62·5	62·7	62·9	63·1	63·3
·590	59·5	59·6	59·8	60·1	60·4	60·7	61·0	61·3	61·7	61·9	62·1	62·3	62·5	62·7	62·9
·600	59·0	59·1	59·4	59·7	60·0	60·3	60·6	60·9	61·3	61·5	61·7	61·9	62·1	62·3	62·5
·610	58·6	58·7	59·0	59·3	59·6	59·9	60·2	60·5	60·9	61·1	61·3	61·5	61·7	61·9	62·2
·620	58·2	58·3	58·6	58·9	59·2	59·5	59·8	60·1	60·5	60·7	60·9	61·1	61·3	61·5	61·8
·630	57·8	57·9	58·2	58·5	58·8	59·1	59·4	59·7	60·1	60·3	60·5	60·7	60·9	61·1	61·4
·640	57·4	57·5	57·8	58·1	58·4	58·7	59·0	59·3	59·7	59·9	60·1	60·3	60·5	60·8	61·0
·650	57·0	57·1	57·4	57·7	58·0	58·3	58·6	58·9	59·3	59·5	59·7	59·9	60·1	60·4	60·6
·660	56·6	56·7	57·0	57·3	57·6	57·9	58·2	58·5	58·9	59·1	59·3	59·5	59·8	60·0	60·2
·670	56·2	56·3	56·6	56·9	57·2	57·5	57·8	58·2	58·5	58·7	58·9	59·2	59·4	59·6	59·9
·680	55·8	55·9	56·2	56·5	56·8	57·1	57·4	57·8	58·2	58·4	58·6	58·8	59·0	59·3	59·5
·690	55·4	55·5	55·8	56·1	56·4	56·7	57·0	57·4	57·8	58·0	58·2	58·4	58·6	58·9	59·1
·700	55·0	55·1	55·4	55·7	56·1	56·3	56·7	57·0	57·4	57·6	57·8	58·0	58·3	58·5	58·8
·710	54·6	54·7	55·0	55·3	55·7	56·0	56·3	56·6	57·0	57·2	57·5	57·7	57·9	58·2	58·4
·720	54·2	54·3	54·7	54·9	55·3	55·6	55·9	56·3	56·7	56·9	57·1	57·3	57·6	57·8	58·1
·730	53·9	54·0	54·3	54·6	54·9	55·2	55·6	55·9	56·3	56·5	56·7	57·0	57·2	57·4	57·7
·740	53·5	53·6	53·9	54·2	54·6	54·9	55·2	55·5	55·9	56·2	56·4	56·6	56·8	57·1	57·3
·750	53·1	53·2	53·6	53·8	54·2	54·5	54·8	55·2	55·6	55·8	56·0	56·2	56·5	56·7	57·0
·760	52·8	52·9	53·2	53·5	53·8	54·1	54·5	54·8	55·2	55·4	55·7	55·9	56·1	56·4	56·6
·770	52·4	52·5	52·8	53·1	53·5	53·8	54·1	54·5	54·9	55·1	55·3	55·5	55·8	56·0	56·3
·780	52·0	52·2	52·5	52·8	53·1	53·4	53·8	54·1	54·5	54·7	55·0	55·2	55·4	55·7	56·0
·790	51·7	51·8	52·1	52·4	52·8	53·1	53·4	53·8	54·2	54·4	54·6	54·9	55·1	55·4	55·6
·800	51·3	51·4	51·8	52·1	52·4	52·7	53·1	53·4	53·8	54·1	54·3	54·5	54·8	55·0	55·3
·810	51·0	51·1	51·4	51·7	52·1	52·4	52·7	53·1	53·5	53·7	53·9	54·2	54·4	54·7	55·0
·820	50·6	50·8	51·1	51·4	51·8	52·1	52·4	52·8	53·2	53·4	53·6	53·8	54·1	54·4	54·6
·830	50·3	50·4	50·7	51·0	51·4	51·7	52·0	52·4	52·8	53·0	53·3	53·5	53·8	54·0	54·3
·840	50·0	50·1	50·4	50·7	51·1	51·4	51·7	52·1	52·5	52·7	52·9	53·2	53·4	53·7	54·0
·850	49·6	49·7	50·1	50·4	50·7	51·0	51·4	51·8	52·2	52·4	52·6	52·9	53·1	53·4	53·6
·860	49·3	49·4	49·7	50·0	50·4	50·7	51·1	51·4	51·8	52·1	52·3	52·5	52·8	53·1	53·3
·870	49·0	49·1	49·4	49·7	50·1	50·4	50·7	51·1	51·5	51·7	52·0	52·2	52·5	52·7	53·0
·880	48·7	48·8	49·1	49·4	49·8	50·1	50·4	50·8	51·2	51·4	51·7	51·9	52·2	52·4	52·7
·890	48·3	48·4	48·8	49·1	49·5	49·8	50·1	50·5	50·9	51·1	50·3	50·6	50·8	52·1	52·4
·900	48·0	48·1	48·4	48·8	49·1	49·4	49·8	50·2	50·6	50·8	51·0	51·3	51·5	51·8	52·1
·910	47·7	47·8	48·1	48·4	48·8	49·1	49·5	49·8	50·3	50·5	50·7	51·0	51·2	51·5	51·8
·920	47·4	47·5	47·8	48·1	48·5	48·8	49·2	49·5	50·0	50·2	50·4	50·7	50·9	51·2	51·5
·930	47·1	47·2	47·5	47·8	48·2	48·5	48·8	49·2	49·6	49·9	50·1	50·4	50·6	50·9	51·2
·940	46·8	46·9	47·2	47·5	47·9	48·2	48·5	48·9	49·3	49·6	49·8	50·1	50·3	50·6	50·9
·950	46·5	46·6	46·9	47·2	47·6	47·9	48·2	48·6	49·0	49·3	49·5	49·8	50·0	50·3	50·6
·960	46·2	46·3	46·6	46·9	47·3	47·6	47·9	48·3	48·7	49·0	49·2	49·5	49·7	50·0	50·3
·970	45·9	46·0	46·3	46·6	47·0	47·3	47·7	48·0	48·5	48·7	48·9	49·2	49·4	49·7	50·0
·980	45·6	45·7	46·0	46·3	46·7	47·0	47·4	47·7	48·2	48·4	48·6	48·9	49·1	49·4	49·7
·990	45·3	45·4	45·7	46·0	46·4	46·7	47·1	47·5	47·9	48·1	48·3	48·6	48·8	49·1	49·4

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	00°	6°	10°	13°	16°	18°	20°	22°	24°	25°	26°	27°	28°	29°	30°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1·00	45·0	45·1	45·4	45·7	46·1	46·4	46·8	47·2	47·6	47·8	48·1	48·3	48·6	48·8	49·1
1·02	44·4	44·5	44·9	45·2	45·6	45·9	46·2	46·6	47·0	47·2	47·5	47·7	48 o	48·3	48·5
1·04	43·9	44·0	44·3	44·6	45·0	45·3	45·7	46·0	46·5	46·7	46·9	47·2	47·4	47·7	48·0
1·06	43·3	43·4	43·8	44·1	44·5	44·8	45·1	45·5	45·9	46·1	46·4	46·6	46·9	47·2	47·4
1·08	42·8	42·9	43·2	43·5	43·9	44·2	44·6	45·0	45·4	45·6	45·9	46·1	46·4	46·6	46·9
1·10	42·3	42·4	42·7	43·0	43·4	43·7	44·1	44·4	44·9	45·1	45·3	45·6	45·8	46·1	46·4
1·12	41·8	41·9	42·2	42·5	42·9	43·2	43·5	43·9	44·3	44·6	44·8	45·1	45·3	45·6	45·9
1·14	41·3	41·4	41·7	42·0	42·4	42·7	43·0	43·4	43·8	44·1	44·3	44·6	44·8	45·1	45·4
1·16	40·8	40·9	41·2	41·5	41·9	42·2	42·5	42·9	43·3	43·6	43·8	44·1	44·3	44·6	44·9
1·18	40·3	40·4	40·7	41·0	41·4	41·7	42·0	42·4	42·9	43·1	43·3	43·6	43·8	44·1	44·4
1·20	39·8	39·9	40·2	40·5	40·9	41·2	41·6	41·9	42·4	42·6	42·8	43·1	43·3	43·6	43·9
1·22	39·3	39·4	39·8	40·1	40·5	40·8	41·1	41·5	41·9	42·1	42·4	42·6	42·9	43·1	43·4
1·24	38·9	39·0	39·3	39·6	40·0	40·3	40·6	41·0	41·4	41·7	41·9	42·1	42·4	42·7	43·0
1·26	38·4	38·5	38·9	39·2	39·5	39·8	40·2	40·6	41·0	41·2	41·4	41·7	42·0	42·2	42·5
1·28	38·0	38·1	38·4	38·7	39·1	39·4	39·7	40·1	40·5	40·8	41·0	41·2	41·5	41·8	42·1
1·30	37·6	37·7	38·0	38·3	38·7	39·0	39·3	39·7	40·1	40·3	40·6	40·8	41·1	41·3	41·6
1·32	37·1	37·3	37·6	37·9	38·2	38·5	38·9	39·3	39·7	39·9	40·1	40·4	40·6	40·9	41·2
1·34	36·7	36·8	37·2	37·4	37·8	38·1	38·5	38·8	39·2	39·5	39·7	39·9	40·2	40·5	40·8
1·36	36·3	36·4	36·7	37·0	37·4	37·7	38·0	38·4	38·8	39·1	39·3	39·5	39·8	40·1	40·3
1·38	35·9	36·0	36·3	36·6	37·0	37·3	37·6	38·0	38·4	38·6	38·9	39·1	39·4	39·6	39·9
1·40	35·5	35·6	36·0	36·2	36·6	36·9	37·2	37·6	38·0	38·2	38·5	38·7	39·0	39·2	39·5
1·42	35·2	35·3	35·6	35·9	36·2	36·5	36·8	37·2	37·6	37·8	38·1	38·3	38·6	38·8	39·1
1·44	34·8	34·9	35·2	35·5	35·8	36·1	36·5	36·8	37·2	37·5	37·7	37·9	38·2	38·4	38·7
1·46	34·4	34·5	34·8	35·1	35·5	35·8	36·1	36·5	36·9	37·1	37·3	37·6	37·8	38·1	38·3
1·48	34·0	34·1	34·5	34·7	35·1	35·4	35·7	36·1	36·5	36·7	36·9	37·2	37·4	37·7	38·0
1·50	33·7	33·8	34·1	34·4	34·7	35·0	35·4	35·7	36·1	36·3	36·6	36·8	37·1	37·3	37·6
1·52	33·3	33·4	33·7	34·0	34·4	34·7	35·0	35·4	35·8	36·0	36·2	36·4	36·7	36·9	37·2
1·54	33·0	33·1	33·4	33·7	34·0	34·3	34·6	35·0	35·4	35·6	35·8	36·1	36·3	36·6	36·9
1·56	32·7	32·8	33·1	33·3	33·7	34·0	34·3	34·7	35·1	35·3	35·5	35·7	36·0	36·2	36·5
1·58	32·3	32·4	32·7	33·0	33·4	33·6	34·0	34·3	34·7	34·9	35·1	35·4	35·6	35·9	36·2
1·60	32·0	32·1	32·4	32·7	33·0	33·3	33·6	34·0	34·4	34·6	34·8	35·0	35·3	35·5	35·8
1·62	31·7	31·8	32·1	32·4	32·7	33·0	33·3	33·7	34·0	34·3	34·5	34·7	35·0	35·2	35·5
1·64	31·4	31·5	31·8	32 o	32·4	32·7	33·0	33·3	33·7	33·9	34·2	34·4	34·6	34·9	35·1
1·66	31·1	31·2	31·5	31·7	32·1	32·4	32·7	33·0	33·4	33·6	33·8	34·1	34·3	34·6	34·8
1·68	30·8	30·9	31·1	31·4	31·8	32·0	32·4	32·7	33·1	33·3	33·5	33·7	34·0	34·2	34·5
1·70	30·5	30·6	30·9	31·1	31·5	31·7	32·0	32·4	32·8	33·0	33·2	33·4	33·7	33·9	34·2
1·72	30·2	30·3	30·6	30·8	31·2	31·4	31·7	32·1	32·5	32·7	32·9	33·1	33·4	33·6	33·9
1·74	29·9	30·0	30·3	30·5	30·9	31·1	31·4	31·8	32·2	32·4	32·6	32·8	33·1	33·3	33·6
1·76	29·6	29·7	30·0	30·2	30·6	30·9	31·2	31·5	31·9	32·1	32·3	32·5	32·8	33·0	33·3
1·78	29·3	29·4	29·7	30·0	30·3	30·6	30·9	31·2	31·6	31·8	32·0	32·2	32·5	32·7	33·0
1·80	29·1	29·1	29·4	29·7	30·0	30·3	30·6	30·9	31·3	31·5	31·7	31·9	32·2	32·4	32·7
1·82	28·8	28·9	29·2	29·4	29·8	30·0	30·3	30·7	31·0	31·2	31·4	31·7	31·9	32·1	32·4
1·84	28·5	28·6	28·9	29·2	29·5	29·7	30·0	30·4	30·7	30·9	31·2	31·4	31·6	31·9	32·1
1·86	28·3	28·4	28·6	28·9	29·2	29·5	29·8	30·1	30·5	30·7	30·9	31·1	31·3	31·6	31·8
1·88	28·0	28·1	28·4	28·6	29·0	29·2	29·5	29·8	30·2	30·4	30·6	30·8	31·1	31·3	31·6
1·90	27·8	27·8	28·1	28·4	28·7	29·0	29·3	29·6	29·9	30·1	30·4	30·6	30·8	31·0	31·3
1·92	27·5	27·6	27·9	28·1	28·4	28·7	29·0	29·3	29·7	29·9	30·1	30·3	30·5	30·8	31·0
1·94	27·3	27·4	27·6	27·9	28·2	28·5	28·7	29·1	29·4	29·6	29·8	30·1	30·3	30·5	30·8
1·96	27·0	27·1	27·4	27·6	28·0	28·2	28·5	28·8	29·2	29·4	29·6	29·8	30·0	30·3	30·5
1·98	26·8	26·9	27·2	27·4	27·7	28·0	28·3	28·6	29·0	29·1	29·3	29·5	29·8	30·0	30·2

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.															
	00°	5°	10°	15°	16°	18°	20°	22°	24°	25°	26°	27°	28°	29°	30°
	AZIMUTHS.															
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
2·00	26·6	26·7	26·9	27·2	27·5	27·7	28·0	28·3	28·7	28·9	29·1	29·3	29·5	29·8	30·0
2·05	26·0	26·1	26·4	26·6	26·9	27·2	27·4	27·7	28·1	28·3	28·5	28·7	28·9	29·1	29·4
2·10	25·5	25·5	25·8	26·0	26·4	26·6	26·9	27·2	27·5	27·7	27·9	28·1	28·3	28·6	28·8
2·15	24·9	25·0	25·3	25·5	25·8	26·1	26·3	26·6	27·0	27·2	27·4	27·6	27·8	28·0	28·2
2·20	24·4	24·5	24·8	25·0	25·3	25·5	25·8	26·1	26·5	26·6	26·8	27·0	27·2	27·5	27·7
2·25	24·0	24·0	24·3	24·5	24·8	25·0	25·3	25·6	25·9	26·1	26·3	26·5	26·7	26·9	27·2
2·30	23·5	23·6	23·8	24·0	24·3	24·6	24·8	25·1	25·5	25·6	25·8	26·0	26·2	26·4	26·7
2·40	22·6	22·7	22·9	23·2	23·4	23·7	23·9	24·2	24·5	24·7	24·9	25·1	25·3	25·5	25·7
2·50	21·8	21·9	22·1	22·3	22·6	22·8	23·1	23·3	23·6	23·8	24·0	24·2	24·4	24·6	24·8
2·60	21·0	21·1	21·3	21·5	21·8	22·0	22·3	22·5	22·8	23·0	23·2	23·3	23·5	23·7	23·9
2·70	20·3	20·4	20·6	20·8	21·1	21·3	21·5	21·8	22·1	22·2	22·4	22·6	22·8	23·0	23·2
2·80	19·7	19·7	19·9	20·1	20·4	20·6	20·8	21·1	21·4	21·5	21·7	21·8	22·0	22·2	22·4
2·90	19·0	19·1	19·3	19·5	19·7	19·9	20·2	20·4	20·7	20·8	21·0	21·2	21·3	21·5	21·7
3·00	18·4	18·5	18·7	18·9	19·1	19·3	19·5	19·8	20·0	20·2	20·3	20·5	20·7	20·9	21·1
3·10	17·9	17·9	18·1	18·3	18·6	18·7	18·9	19·2	19·4	19·6	19·7	19·9	20·1	20·2	20·4
3·20	17·4	17·4	17·6	17·8	18·0	18·2	18·4	18·6	18·9	19·0	19·2	19·3	19·5	19·7	19·8
3·30	16·9	16·9	17·1	17·3	17·5	17·7	17·9	18·1	18·4	18·5	18·6	18·8	18·9	19·1	19·3
3·40	16·4	16·4	16·6	16·8	17·0	17·2	17·4	17·6	17·8	18·0	18·1	18·3	18·4	18·6	18·8
3·60	15·5	15·6	15·8	15·9	16·1	16·3	16·5	16·7	16·9	17·0	17·2	17·3	17·5	17·6	17·8
3·80	14·7	14·8	15·0	15·1	15·3	15·5	15·6	15·8	16·1	16·2	16·3	16·5	16·6	16·7	16·9
4·00	14·0	14·1	14·2	14·4	14·6	14·7	14·9	15·1	15·3	15·4	15·5	15·7	15·8	16·0	16·1
4·20	13·4	13·4	13·6	13·7	13·9	14·1	14·2	14·4	14·6	14·7	14·8	15·0	15·1	15·2	15·4
4·40	12·8	12·9	13·0	13·1	13·3	13·4	13·6	13·8	14·0	14·1	14·2	14·3	14·4	14·6	14·7
4·60	12·3	12·3	12·4	12·6	12·7	12·9	13·0	13·2	13·4	13·5	13·6	13·7	13·8	14·0	14·1
4·80	11·8	11·8	11·9	12·1	12·2	12·4	12·5	12·7	12·8	12·9	13·1	13·2	13·3	13·4	13·5
5·00	11·3	11·4	11·5	11·6	11·8	11·9	12·0	12·2	12·3	12·4	12·5	12·7	12·8	12·9	13·0
5·50	10·3	10·3	10·5	10·6	10·7	10·8	11·0	11·1	11·3	11·3	11·4	11·5	11·6	11·7	11·9
6·00	9·5	9·5	9·6	9·7	9·8	9·9	10·1	10·2	10·3	10·4	10·5	10·6	10·7	10·8	10·9
6·50	8·7	8·8	8·9	9·0	9·1	9·2	9·3	9·4	9·6	9·6	9·7	9·8	9·9	10·0	10·1
7·00	8·1	8·2	8·3	8·3	8·5	8·5	8·6	8·8	8·9	9·0	9·0	9·1	9·2	9·3	9·4
8·0	7·1	7·2	7·2	7·3	7·4	7·5	7·6	7·7	7·8	7·9	7·9	8·0	8·1	8·1	8·2
9·0	6·3	6·4	6·4	6·5	6·6	6·7	6·7	6·8	6·9	7·0	7·0	7·1	7·2	7·2	7·3
10·0	5·7	5·7	5·8	5·9	5·9	6·0	6·1	6·2	6·2	6·3	6·3	6·4	6·5	6·5	6·6
11·0	5·2	5·2	5·3	5·3	5·4	5·5	5·5	5·6	5·7	5·7	5·8	5·8	5·9	5·9	6·0
12·0	4·8	4·8	4·8	4·9	5·0	5·0	5·1	5·1	5·2	5·3	5·3	5·3	5·4	5·5	5·5
13·0	4·4	4·4	4·5	4·5	4·6	4·6	4·7	4·7	4·8	4·9	4·9	4·9	5·0	5·0	5·1
15·0	3·8	3·8	3·9	3·9	4·0	4·0	4·1	4·1	4·2	4·2	4·2	4·3	4·3	4·4	4·4
17·0	3·4	3·4	3·4	3·5	3·5	3·5	3·6	3·6	3·7	3·7	3·7	3·8	3·8	3·8	3·9
20·0	2·9	2·9	2·9	2·9	3·0	3·0	3·0	3·1	3·1	3·2	3·2	3·2	3·2	3·3	3·3
25·0	2·3	2·3	2·3	2·4	2·4	2·4	2·4	2·5	2·5	2·5	2·5	2·6	2·6	2·6	2·6
30·0	1·9	1·9	1·9	2·0	2·0	2·0	2·0	2·1	2·1	2·1	2·1	2·1	2·2	2·2	2·2
40·0	1·4	1·4	1·5	1·5	1·5	1·5	1·5	1·5	1·6	1·6	1·6	1·6	1·6	1·6	1·7
50·0	1·1	1·2	1·2	1·2	1·2	1·2	1·2	1·2	1·3	1·3	1·3	1·3	1·3	1·3	1·3
70·0	0·8	0·8	0·8	0·8	0·9	0·9	0·9	0·9	0·9	0·9	0·9	0·9	0·9	0·9	0·9
100·0	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·7	0·7
150·0	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4
200·0	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3
300·0	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2
400·0	0·1	0·1	0·1	0·1	0·1	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2
800·0	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·000	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0
·010	89·5	89·5	89·5	89·5	89·5	89·5	89·5	89·5	89·6	89·6	89·6	89·6	89·6	89·6	89·6
·020	89·0	89·0	89·0	89·1	89·1	89·1	89·1	89·1	89·1	89·1	89·1	89·1	89·2	89·2	89·2
·030	88·5	88·5	88·6	88·6	88·6	88·6	88·6	88·6	88·7	88·7	88·7	88·7	88·7	88·8	88·8
·040	88·0	88·1	88·1	88·1	88·1	88·1	88·2	88·2	88·2	88·2	88·3	88·3	88·3	88·4	88·4
·050	87·5	87·6	87·6	87·6	87·7	87·7	87·7	87·7	87·8	87·8	87·8	87·9	87·9	87·9	88·0
·060	87·1	87·1	87·1	87·2	87·2	87·2	87·3	87·3	87·3	87·4	87·4	87·4	87·5	87·5	87·6
·070	86·6	86·6	86·6	86·7	86·7	86·8	86·8	86·8	86·9	86·9	87·0	87·0	87·1	87·1	87·2
·080	86·1	86·1	86·2	86·2	86·3	86·3	86·3	86·4	86·4	86·5	86·5	86·6	86·7	86·7	86·8
·090	85·6	85·6	85·7	85·7	85·8	85·8	85·9	85·9	86·0	86·1	86·1	86·2	86·2	86·3	86·4
·100	85·1	85·2	85·2	85·3	85·3	85·4	85·4	85·5	85·6	85·6	85·7	85·7	85·8	85·9	86·0
·110	84·6	84·7	84·7	84·8	84·9	84·9	85·0	85·0	85·1	85·2	85·3	85·3	85·4	85·5	85·6
·120	84·1	84·2	84·3	84·3	84·4	84·5	84·5	84·6	84·7	84·7	84·8	84·9	85·0	85·1	85·1
·130	83·6	83·7	83·8	83·8	83·9	84·0	84·1	84·2	84·2	84·3	84·4	84·5	84·6	84·7	84·7
·140	83·2	83·2	83·3	83·4	83·5	83·5	83·6	83·7	83·8	83·9	84·0	84·1	84·2	84·2	84·3
·150	82·7	82·8	82·8	82·9	83·0	83·1	83·2	83·3	83·4	83·4	83·5	83·6	83·7	83·8	83·9
·160	82·2	82·3	82·4	82·4	82·5	82·6	82·7	82·8	82·9	83·0	83·1	83·2	83·3	83·4	83·5
·170	81·7	81·8	81·9	82·0	82·1	82·2	82·3	82·4	82·5	82·6	82·7	82·8	82·9	83·0	83·1
·180	81·2	81·3	81·4	81·5	81·6	81·7	81·8	81·9	82·0	82·1	82·3	82·4	82·5	82·6	82·7
·190	80·7	80·8	80·9	81·0	81·2	81·3	81·4	81·5	81·6	81·7	81·8	82·0	82·1	82·2	82·3
·200	80·3	80·4	80·5	80·6	80·7	80·8	80·9	81·0	81·2	81·3	81·4	81·5	81·7	81·8	82·0
·210	79·8	79·9	80·0	80·1	80·2	80·4	80·5	80·6	80·7	80·9	81·0	81·1	81·3	81·4	81·6
·220	79·3	79·4	79·5	79·7	79·8	79·9	80·0	80·2	80·3	80·4	80·6	80·7	80·9	81·0	81·2
·230	78·8	79·0	79·1	79·2	79·3	79·5	79·6	79·7	79·9	80·0	80·2	80·3	80·5	80·6	80·8
·240	78·4	78·5	78·6	78·7	78·9	79·0	79·1	79·3	79·4	79·6	79·7	79·9	80·0	80·2	80·4
·250	77·9	78·0	78·2	78·3	78·4	78·6	78·7	78·9	79·0	79·2	79·3	79·5	79·6	79·8	80·0
·260	77·4	77·6	77·7	77·8	78·0	78·1	78·3	78·4	78·6	78·7	78·9	79·1	79·2	79·4	79·6
·270	77·0	77·1	77·2	77·4	77·5	77·7	77·8	78·0	78·1	78·3	78·5	78·7	78·8	79·0	79·2
·280	76·5	76·6	76·8	76·9	77·1	77·2	77·4	77·6	77·7	77·9	78·1	78·2	78·4	78·6	78·8
·290	76·0	76·2	76·3	76·5	76·6	76·8	77·0	77·1	77·3	77·5	77·7	77·8	78·0	78·2	78·4
·300	75·6	75·7	75·9	76·0	76·2	76·4	76·5	76·7	76·9	77·1	77·2	77·4	77·6	77·8	78·0
·310	75·1	75·3	75·4	75·6	75·8	75·9	76·1	76·3	76·5	76·6	76·8	77·0	77·2	77·4	77·6
·320	74·7	74·8	75·0	75·1	75·3	75·5	75·7	75·8	76·0	76·2	76·4	76·6	76·8	77·0	78·3
·330	74·2	74·4	74·5	74·7	74·9	75·1	75·2	75·4	75·6	75·8	76·0	76·2	76·4	76·6	76·9
·340	73·8	73·9	74·1	74·3	74·4	74·6	74·8	75·0	75·2	75·4	75·6	75·8	76·0	76·3	76·5
·350	73·3	73·5	73·6	73·8	74·0	74·2	74·4	74·6	74·8	75·0	75·2	75·4	75·6	75·9	76·1
·360	72·9	73·0	73·2	73·4	73·6	73·8	74·0	74·2	74·4	74·6	74·8	75·0	75·2	75·5	75·7
·370	72·4	72·6	72·8	72·9	73·1	73·3	73·5	73·7	74·0	74·2	74·4	74·6	74·9	75·1	75·3
·380	72·0	72·1	72·3	72·5	72·7	72·9	73·1	73·3	73·5	73·8	74·0	74·2	74·5	74·7	75·0
·390	71·5	71·7	71·9	72·1	72·3	72·5	72·7	72·9	73·1	73·4	73·6	73·8	74·1	74·3	74·6
·400	71·1	71·3	71·5	71·7	71·9	72·1	72·3	72·5	72·7	73·0	73·2	73·4	73·7	73·9	74·2
·410	70·6	70·8	71·0	71·2	71·4	71·6	71·9	72·1	72·3	72·6	72·8	73·1	73·3	73·6	73·8
·420	70·2	70·4	70·6	70·8	71·0	71·2	71·5	71·7	71·9	72·2	72·4	72·7	72·9	73·2	73·5
·430	69·8	70·0	70·2	70·4	70·6	70·8	71·0	71·3	71·5	71·8	72·0	72·3	72·5	72·8	73·1
·440	69·3	69·5	69·7	70·0	70·2	70·4	70·6	70·9	71·1	71·4	71·6	71·9	72·2	72·4	72·7
·450	68·9	69·1	69·3	69·5	69 8	70·0	70·2	70·5	70·7	71·0	71·2	71·5	71·8	72·1	72·3
·460	68·5	68·7	68·9	69·1	69·4	69·6	69·8	70·1	70·3	70·6	70·9	71·1	71·4	71·7	72·0
·470	68·1	68·3	68·5	68·7	68·9	69·2	69·4	69·7	69·9	70·2	70·5	70·7	71·0	71·3	71·6
·480	67·6	67·9	68·1	68·3	68·5	68·8	69·0	69·3	69·5	69·8	70·1	70·4	70·7	71·0	71·3
·490	67·2	67·4	67·7	67·9	68·1	68·4	68·6	68·9	69·2	69·4	69·7	70·0	70·3	70·6	70·9

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·500	66·8	67·0	67·2	67·5	67·7	68·0	68·2	68·5	68·8	69·0	69·3	69·6	69·9	70·2	70·5
·510	66·4	66·6	66·8	67·1	67·3	67·6	67·8	68·1	68·4	68·7	68·9	69·2	69·5	69·9	70·2
·520	66·0	66·2	66·4	66·7	66·9	67·2	67·4	67·7	68·0	68·3	68·6	68·9	69·2	69·5	69·8
·530	65·6	65·8	66·0	66·3	66·5	66·8	67·1	67·3	67·6	67·9	68·2	68·5	68·8	69·1	69·5
·540	65·2	65·4	65·6	65·9	66·1	66·4	66·7	66·9	67·2	67·5	67·8	68·1	68·4	68·8	69·1
·550	64·8	65·0	65·2	65·5	65·7	66·0	66·3	66·6	66·9	67·2	67·5	67·8	68·1	68·4	68·7
·560	64·4	64·6	64·8	65·1	65·4	65·6	65·9	66·2	66·5	66·8	67·1	67·4	67·7	68·1	68·4
·570	64·0	64·2	64·5	64·7	65·0	65·2	65·5	65·8	66·1	66·4	66·7	67·0	67·4	67·7	68·0
·580	63·6	63·8	64·1	64·3	64·6	64·9	65·1	65·4	65·7	66·0	66·4	66·7	67·0	67·4	67·7
·590	63·2	63·4	63·7	63·9	64·2	64·5	64·8	65·1	65·4	65·7	66·0	66·3	66·7	67·0	67·4
·600	62·8	63·0	63·3	63·6	63·8	64·1	64·4	64·7	65·0	65·3	65·6	66·0	66·3	66·7	67·0
·610	62·4	62·6	62·9	63·2	63·4	63·7	64·0	64·3	64·6	65·0	65·3	65·6	66·0	66·3	66·7
·620	62·0	62·3	62·5	62·8	63·1	63·4	63·7	64·0	64·3	64·6	64·9	65·3	65·6	66·0	66·3
·630	61·6	61·9	62·1	62·4	62·7	63·0	63·3	63·6	63·9	64·2	64·6	64·9	65·3	65·6	66·0
·640	61·3	61·5	61·8	62·1	62·3	62·6	62·9	63·2	63·6	63·9	64·2	64·6	64·9	65·3	65·7
·650	60·9	61·1	61·4	61·7	62·0	62·3	62·6	62·9	63·2	63·5	63·9	64·2	64·6	64·9	65·3
·660	60·5	60·8	61·0	61·3	61·6	61·9	62·2	62·5	62·8	63·2	63·5	63·9	64·2	64·6	65·0
·670	60·1	60·4	60·7	60·9	61·2	61·5	61·8	62·2	62·5	62·8	63·2	63·5	63·9	64·3	64·7
·680	59·8	60·0	60·3	60·6	60·9	61·2	61·5	61·8	62·1	62·5	62·8	63·2	63·6	63·9	64·3
·690	59·4	59·7	59·9	60·2	60·5	60·8	61·1	61·5	61·8	62·1	62·5	62·9	63·2	63·6	64·0
·700	59·0	59·3	59·6	59·9	60·2	60·5	60·8	61·1	61·5	61·8	62·2	62·5	62·9	63·3	63·7
·710	58·7	58·9	59·2	59·5	59·8	60·1	60·4	60·8	61·1	61·5	61·8	62·2	62·6	62·9	63·3
·720	58·3	58·6	58·9	59·2	59·5	59·8	60·1	60·4	60·8	61·1	61·5	61·9	62·2	62·6	63·0
·730	58·0	58·2	58·5	58·8	59·1	59·4	59·8	60·1	60·4	60·8	61·1	61·5	61·9	62·3	62·7
·740	57·6	57·9	58·2	58·5	58·8	59·1	59·4	59·8	60·1	60·5	60·8	61·2	61·6	62·0	62·4
·750	57·3	57·5	57·8	58·1	58·4	58·8	59·1	59·4	59·8	60·1	60·5	60·9	61·3	61·7	62·1
·760	56·9	57·2	57·5	57·8	58·1	58·4	58·7	59·1	59·4	59·8	60·2	60·5	60·9	61·3	61·7
·770	56·6	56·9	57·1	57·4	57·8	58·1	58·4	58·8	59·1	59·5	59·8	60·2	60·6	61·0	61·4
·780	56·2	56·5	56·8	57·1	57·4	57·7	58·1	58·4	58·8	59·1	59·5	59·9	60·3	60·7	61·1
·790	55·9	56·2	56·5	56·8	57·1	57·4	57·8	58·1	58·5	58·8	59·2	59·6	60·0	60·4	60·8
·800	55·6	55·8	56·1	56·4	56·8	57·1	57·4	57·8	58·1	58·5	58·9	59·3	59·7	60·1	60·5
·810	55·2	55·5	55·8	56·1	56·4	56·8	57·1	57·4	57·8	58·2	58·6	59·0	59·4	59·8	60·2
·820	54·9	55·2	55·5	55·8	56·1	56·4	56·8	57·1	57·5	57·9	58·2	58·6	59·0	59·5	59·9
·830	54·6	54·9	55·2	55·5	55·8	56·1	56·5	56·8	57·2	57·6	57·9	58·3	58·7	59·2	59·6
·840	54·2	54·5	54·8	55·1	55·5	55·8	56·1	56·5	56·9	57·2	57·6	58·0	58·4	58·9	59·3
·850	53·9	54·2	54·5	54·8	55·2	55·5	55·8	56·2	56·6	56·9	57·3	57·7	58·1	58·6	59·0
·860	53·6	53·9	54·2	54·5	54·8	55·2	55·5	55·9	56·2	56·6	57·0	57·4	57·8	58·3	58·7
·870	53·3	53·6	53·9	54·2	54·5	54·9	55·2	55·6	55·9	56·3	56·7	57·1	57·5	58·0	58·4
·880	53·0	53·3	53·6	53·9	54·2	54·6	54·9	55·3	55·6	56·0	56·4	56·8	57·2	57·7	58·1
·890	52·7	53·0	53·3	53·6	53·9	54·2	54·6	55·0	55·3	55·7	56·1	56·5	56·9	57·4	57·8
·900	52·4	52·6	53·0	53·3	53·6	53·9	54·3	54·7	55·0	55·4	55·8	56·2	56·6	57·1	57·5
·910	52·0	52·3	52·6	53·0	53·3	53·6	54·0	54·4	54·7	55·1	55·5	55·9	56·4	56·8	57·2
·920	51·7	52·0	52·3	52·7	53·0	53·3	53·7	54·1	54·4	54·8	55·2	55·6	56·1	56·5	57·0
·930	51·4	51·7	52·0	52·4	52·7	53·0	53·4	53·8	54·1	54·5	54·9	55·4	55·8	56·2	56·7
·940	51·1	51·4	51·7	52·1	52·4	52·7	53·1	53·5	53·9	54·2	54·6	55·1	55·5	55·9	56·4
·950	50·8	51·1	51·5	51·8	52·1	52·5	52·8	53·2	53·6	54·0	54·4	54·8	55·2	55·7	56·1
·960	50·5	50·9	51·2	51·5	51·8	52·2	52·5	52·9	53·3	53·7	54·1	54·5	54·9	55·4	55·8
·970	50·3	50·6	50·9	51·2	51·5	51·9	52·2	52·6	53·0	53·4	53·8	54·2	54·6	55·1	55·6
·980	50·0	50·3	50·6	50·9	51·2	51·6	52·0	52·3	52·7	53·1	53·5	53·9	54·4	54·8	55·3
·990	49·7	50·0	53·3	50·6	51·0	51·3	51·7	52·0	52·4	52·8	53·2	53·7	54·1	54·5	55·0

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1·00	49·4	49·7	50·0	50·3	50·7	51·0	51·4	51·8	52·1	52·5	53·0	53·4	53·8	54·3	54·7
1·02	48·8	49·1	49·5	49·8	50·1	50·5	50·8	51·2	51·6	52·0	52·4	52·8	53·3	53·7	54·2
1·04	48·3	48·6	48·9	49·2	49·6	49·9	50·3	50·7	51·1	51·5	51·9	52·3	52·7	53·2	53·7
1·06	47·7	48·0	48·4	48·7	49·0	49·4	49·8	50·1	50·5	50·9	51·3	51·8	52·2	52·7	53·1
1·08	47·2	47·5	47·8	48·2	48·5	48·9	49·2	49·6	50·0	50·4	50·8	51·2	51·7	52·2	52·6
1·10	46·7	47·0	47·3	47·6	48·0	48·3	48·7	49·1	49·5	49·9	50·3	50·7	51·2	51·6	52·1
1·12	46·2	46·5	46·8	47·1	47·5	47·8	48·2	48·6	49·0	49·4	49·8	50·2	50·7	51·1	51·6
1·14	45·7	46·0	46·3	46·6	47·0	47·3	47·7	48·1	48·5	48·9	49·3	49·7	50·2	50·6	51·1
1·16	45·2	45·5	45·8	46·1	46·5	46·8	47·2	47·6	48·0	48·4	48·8	49·2	49·7	50·2	50·6
1·18	44·7	45·0	45·3	45·6	46·0	46·3	46·7	47·1	47·5	47·9	48·3	48·8	49·2	49·7	50·2
1·20	44·2	44·5	44·8	45·1	45·5	45·8	46·2	46·6	47·0	47·4	47·8	48·3	48·7	49·2	49·7
1·22	43·7	44·0	44·3	44·7	45·0	45·4	45·7	46·1	46·5	46·9	47·4	47·8	48·3	48·7	49·2
1·24	43·3	43·6	43·9	44·2	44·6	44·9	45·3	45·7	46·1	46·5	46·9	47·3	47·8	48·3	48·8
1·26	42·8	43·1	43·4	43·8	44·1	44·5	44·8	45·2	45·6	46·0	46·4	46·9	47·3	47·8	48·3
1·28	42·3	42·7	43·0	43·3	43·6	44·0	44·4	44·8	45·2	45·6	46·0	46·4	46·9	47·4	47·9
1·30	41·9	42·2	42·5	42·9	43·2	43·6	43·9	44·3	44·7	45·1	45·5	46·0	46·4	46·9	47·4
1·32	41·5	41·8	42·1	42·4	42·8	43·1	43·5	43·9	44·3	44·7	45·1	45·6	46·0	46·5	47·0
1·34	41·0	41·3	41·7	42·0	42·3	42·7	43·1	43·4	43·8	44·3	44·7	45·1	45·6	46·1	46·5
1·36	40·6	40·9	41·2	41·6	41·9	42·3	42·6	43·0	43·4	43·8	44·3	44·7	45·2	45·6	46·1
1·38	40·2	40·5	40·8	41·2	41·5	41·9	42·2	42·6	43·0	43·4	43·8	44·3	44·7	45·2	45·7
1·40	39·8	40·1	40·4	40·7	41·1	41·4	41·8	42·2	42·6	43·0	43·4	43·9	44·3	44·8	45·3
1·42	39·4	39·7	40·0	40·3	40·7	41·0	41·4	41·8	42·2	42·6	43·0	43·5	43·9	44·4	44·9
1·44	39·0	39·3	39·6	39·9	40·3	40·6	41·0	41·4	41·8	42·2	42·6	43·1	43·5	44·0	44·5
1·46	38·6	38·9	39·2	39·6	39·9	40·3	40·6	41·0	41·4	41·8	42·2	42·7	43·1	43·6	44·1
1·48	38·2	38·5	38·9	39·2	39·5	39·9	40·2	40·6	41·0	41·4	41·8	42·3	42·7	43·2	43·7
1·50	37·9	38·2	38·5	38·8	39·1	39·5	39·9	40·2	40·6	41·0	41·5	41·9	42·4	42·8	43·3
1·52	37·5	37·8	38·1	38·4	38·8	39·1	39·5	39·9	40·2	40·7	41·1	41·5	42·0	42·4	42·9
1·54	37·1	37·4	37·7	38·1	38·4	38·8	39·1	39·5	39·9	40·3	40·7	41·1	41·6	42·1	42·6
1·56	36·8	37·1	37·4	37·7	38·0	38·4	38·8	39·1	39·5	39·9	40·3	40·8	41·2	41·7	42·2
1·58	36·4	36·7	37·0	37·4	37·7	38·0	38·4	38·8	39·2	39·6	40·0	40·4	40·9	41·3	41·8
1·60	36·1	36·4	36·7	37·0	37·3	37·7	38·0	38·4	38·8	39·2	39·6	40·1	40·5	41·0	41·5
1·62	35·8	36·1	36·4	36·7	37·0	37·3	37·7	38·1	38·5	38·9	39·3	39·7	40·2	40·6	41·1
1·64	35·4	35·7	36·0	36·3	36·7	37·0	37·4	37·7	38·1	38·5	38·9	39·4	39·8	40·3	40·8
1·66	35·1	35·4	35·7	36·0	36·3	36·7	37·0	37·4	37·8	38·2	38·6	39·0	39·5	39·9	40·4
1·68	34·8	35·1	35·4	35·7	36·0	36·3	36·7	37·1	37·4	37·8	38·3	38·7	39·1	39·6	40·1
1·70	34·5	34·7	35·0	35·4	35·7	36·0	36·4	36·7	37·1	37·5	37·9	38·4	38·8	39·3	39·8
1·72	34·1	34·4	34·7	35·0	35·4	35·7	36·1	36·4	36·8	37·2	37·6	38·0	38·5	38·9	39·4
1·74	33·8	34·1	34·4	34·7	35·1	35·4	35·7	36·1	36·5	36·9	37·3	37·7	38·2	38·6	39·1
1·76	33·5	33·8	34·1	34·4	34·7	35·1	35·4	35·8	36·2	36·6	37·0	37·4	37·8	38·3	38·8
1·78	33·2	33·5	33·8	34·1	34·4	34·8	35·1	35·5	35·9	36·3	36·7	37·1	37·5	38·0	38·5
1·80	32·9	33·2	33·5	33·8	34·1	34·5	34·8	35·2	35·6	36·0	36·4	36·8	37·2	37·7	38·2
1·82	32·7	32·9	33·2	33·5	33·9	34·2	34·5	34·9	35·3	35·7	36·1	36·5	36·9	37·4	37·8
1·84	32·4	32·7	32·9	33·2	33·6	33·9	34·2	34·6	35·0	35·4	35·8	36·2	36·6	37·1	37·5
1·86	32·1	32·4	32·7	33·0	33·3	33·6	33·9	34·3	34·7	35·1	35·5	35·9	36·3	36·8	37·2
1·88	31·8	32·1	32·4	32·7	33·0	33·3	33·7	34·0	34·4	34·8	35·2	35·6	36·0	36·5	37·0
1·90	31·6	31·8	32·1	32·4	32·7	33·0	33·4	33·7	34·1	34·5	34·9	35·3	35·7	36·2	36·7
1·92	31·3	31·6	31·8	32·1	32·4	32·8	33·1	33·5	33·8	34·2	34·6	35·0	35·5	35·9	36·4
1·94	31·0	31·3	31·6	31·9	32·2	32·5	32·8	33·2	33·6	33·9	34·3	34·7	35·2	35·6	36·1
1·96	30·8	31·0	31·3	31·6	31·9	32·2	32·6	32·9	33·3	33·7	34·1	34·5	34·9	35·3	35·8
1·98	30·5	30·8	31·1	31·3	31·7	32·0	32·3	32·7	33·0	33·4	33·8	34·2	34·6	35·1	35·5

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
2·00	30·3	30·5	30·8	31·1	31·4	31·7	32·0	32·4	32·8	33·1	33·5	33·9	34·4	34·8	35·3
2·05	29·6	29·9	30·2	30·5	30·8	31·1	31·4	31·8	32·1	32·5	32·9	33·3	33·7	34·1	34·6
2·10	29·1	29·3	29·6	29·9	30·2	30·5	30·8	31·1	31·5	31·9	32·3	32·7	33·1	33·5	34·0
2·15	28·5	28·7	29·0	29·3	29·6	29·9	30·2	30·6	30·9	31·3	31·6	32·0	32·5	32·9	33·3
2·20	27·9	28·2	28·5	28·7	29·0	29·3	29·6	30·0	30·3	30·7	31·1	31·5	31·9	32·3	32·7
2·25	27·4	27·7	27·9	28·2	28·5	28·8	29·1	29·4	29·8	30·1	30·5	30·9	31·3	31·7	32·2
2·30	26·9	27·1	27·4	27·7	28·0	28·3	28·6	28·9	29·2	29·6	29·9	30·3	30·7	31·1	31·6
2·40	25·9	26·2	26·4	26·7	27·0	27·2	27·6	27·9	28·2	28·5	28·9	29·3	29·7	30·1	30·5
2·50	25·0	25·3	25·5	25·8	26·0	26·3	26·6	26·9	27·2	27·6	27·9	28·3	28·7	29·1	29·5
2·60	24·2	24·4	24·6	24·9	25·2	25·4	25·7	26·0	26·3	26·7	27·0	27·4	27·7	28·1	28·5
2·70	23·4	23·6	23·8	24·1	24·3	24·6	24·9	25·2	25·5	25·8	26·1	26·5	26·9	27·2	27·6
2·80	22·6	22·8	23·1	23·3	23·6	23·8	24·1	24·4	24·7	25·0	25·3	25·7	26·0	26·4	26·8
2·90	21·9	22·1	22·4	22·6	22·8	23·1	23·4	23·6	23·9	24·2	24·6	24·9	25·2	25·6	26·0
3·00	21·2	21·5	21·7	21·9	22·1	22·4	22·7	22·9	23·2	23·5	23·8	24·2	24·5	24·9	25·2
3·10	20·6	20·8	21·0	21·3	21·5	21·7	22·0	22·3	22·5	22·8	23·1	23·5	23·8	24·2	24·5
3·20	20·0	20·2	20·4	20·7	20·9	21·1	21·4	21·6	21·9	22·2	22·5	22·8	23·1	23·5	23·8
3·30	19·5	19·7	19·9	20·1	20·3	20·5	20·8	21·0	21·3	21·6	21·9	22·2	22·5	22·8	23·2
3·40	18·9	19·1	19·3	19·5	19·8	20·0	20·2	20·5	20·7	21·0	21·3	21·6	21·9	22·2	22·6
3·60	18·0	18·1	18·3	18·5	18·7	19·0	19·2	19·4	19·7	19·9	20·2	20·5	20·8	21·1	21·4
3·80	17·1	17·2	17·4	17·6	17·8	18·0	18·2	18·5	18·7	19·0	19·2	19·5	19·8	20·1	20·4
4·00	16·3	16·4	16·6	16·8	17·0	17·2	17·4	17·6	17·8	18·1	18·3	18·6	18·9	19·2	19·5
4·20	15·5	15·7	15·8	16·0	16·2	16·4	16·6	16·8	17·0	17·3	17·5	17·8	18·0	18·3	18·6
4·40	14·9	15·0	15·2	15·3	15·5	15·7	15·9	16·1	16·3	16·5	16·8	17·0	17·3	17·5	17·8
4·60	14·2	14·4	14·5	14·7	14·9	15·0	15·2	15·4	15·6	15·8	16·1	16·3	16·6	16·8	17·1
4·80	13·7	13·8	14·0	14·1	14·3	14·4	14·6	14·8	15·0	15·2	15·4	15·7	15·9	16·2	16·4
5·00	13·1	13·3	13·4	13·6	13·7	13·9	14·1	14·2	14·4	14·6	14·8	15·1	15·3	15·5	15·8
5·50	12·0	12·1	12·2	12·4	12·5	12·7	12·8	13·0	13·2	13·4	13·5	13·7	14·0	14·2	14·4
6·00	11·0	11·1	11·2	11·4	11·5	11·6	11·8	11·9	12·1	12·3	12·5	12·6	12·8	13·0	13·3
6·50	10·2	10·3	10·4	10·5	10·6	10·8	10·9	11·0	11·2	11·4	11·5	11·7	11·9	12·1	12·3
7·00	9·5	9·6	9·7	9·8	9·9	10·0	10·1	10·3	10·4	10·6	10·7	10·9	11·1	11·2	11·4
8·0	8·3	8·4	8·5	8·6	8·7	8·8	8·9	9·0	9·1	9·3	9·4	9·5	9·7	9·9	10·0
9·0	7·4	7·5	7·5	7·6	7·7	7·8	7·9	8·0	8·1	8·3	8·4	8·5	8·6	8·8	8·9
10·0	6·7	6·7	6·8	6·9	7·0	7·0	7·1	7·2	7·3	7·4	7·5	7·7	7·8	7·9	8·0
11·0	6·1	6·1	6·2	6·3	6·3	6·4	6·5	6·6	6·7	6·8	6·9	7·0	7·1	7·2	7·3
12·0	5·6	5·6	5·7	5·7	5·8	5·9	6·0	6·0	6·1	6·2	6·3	6·4	6·5	6·6	6·7
13·0	5·1	5·2	5·2	5·3	5·4	5·4	5·5	5·6	5·7	5·7	5·8	5·9	6·0	6·1	6·2
15·0	4·4	4·5	4·5	4·6	4·7	4·7	4·8	4·8	4·9	5·0	5·0	5·1	5·2	5·3	5·4
17·0	3·9	4·0	4·0	4·1	4·1	4·2	4·2	4·3	4·3	4·4	4·5	4·5	4·6	4·7	4·8
20·0	3·3	3·4	3·4	3·5	3·5	3·5	3·6	3·6	3·7	3·7	3·8	3·8	3·9	4·0	4·0
25·0	2·7	2·7	2·7	2·8	2·8	2·8	2·9	2·9	2·9	3·0	3·0	3·1	3·1	3·2	3·2
30·0	2·2	2·3	2·3	2·3	2·3	2·4	2·4	2·4	2·5	2·5	2·5	2·6	2·6	2·7	2·7
40·0	1·7	1·7	1·7	1·7	1·7	1·8	1·8	1·8	1·8	1·9	1·9	1·9	2·0	2·0	2·0
50·0	1·3	1·4	1·4	1·4	1·4	1·4	1·4	1·5	1·5	1·5	1·5	1·5	1·6	1·6	1·6
70·0	1·0	1·0	1·0	1·0	1·0	1·0	1·0	1·0	1·1	1·1	1·1	1·1	1·1	1·1	1·2
100·0	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·8	0·8	0·8	0·8	0·8
150·0	0·4	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5
200·0	0·3	0·3	0·3	0·3	0·3	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4
300·0	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·3	0·3	0·3	0·3	0·3
400·0	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2
800·0	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
	AZIMOTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·000	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0
·010	89·6	89·6	89·6	89·6	89·6	89·6	89·6	89·7	89·7	89·7	89·7	89·7	89·7	89·7	89·7
·020	89·2	89·2	89·2	89·2	89·3	89·3	89·3	89·3	89·3	89·3	89·4	89·4	89·4	89·4	89·4
·030	88·8	88·8	88·9	88·9	88·9	88·9	88·9	89·0	89·0	89·0	89·0	89·1	89·1	89·1	89·1
·040	88·4	88·4	88·5	88·5	88·5	88·6	88·6	88·6	88·7	88·7	88·7	88·8	88·8	88·8	88·9
·050	88·0	88·0	88·1	88·1	88·2	88·2	88·2	88·3	88·3	88·4	88·4	88·4	88·5	88·5	88·6
·060	87·6	87·7	87·7	87·7	87·8	87·8	87·9	87·9	88·0	88·0	88·1	88·1	88·2	88·2	88·3
·070	87·2	87·3	87·3	87·4	87·4	87·5	87·5	87·6	87·6	87·7	87·8	87·8	87·9	87·9	88·0
·080	86·8	86·9	86·9	87·0	87·1	87·1	87·2	87·2	87·3	87·4	87·4	87·5	87·6	87·6	87·7
·090	86·4	86·5	86·6	86·6	86·7	86·8	86·8	86·9	87·0	87·0	87·1	87·2	87·3	87·3	87·4
·100	86·0	86·1	86·2	86·2	86·3	86·4	86·5	86·6	86·6	86·7	86·8	86·9	87·0	87·1	87·1
·110	85·6	85·7	85·8	85·9	86·0	86·0	86·1	86·2	86·3	86·4	86·5	86·6	86·7	86·8	86·9
·120	85·2	85·3	85·4	85·5	85·6	85·7	85·8	85·9	86·0	86·1	86·2	86·3	86·4	86·5	86·6
·130	84·8	84·9	85·0	85·1	85·2	85·3	85·4	85·5	85·6	85·7	85·8	86·0	86·1	86·2	86·3
·140	84·4	84·5	84·6	84·8	84·9	85·0	85·1	85·2	85·3	85·4	85·5	85·6	85·8	85·9	86·0
·150	84·1	84·2	84·3	84·4	84·5	84·6	84·7	84·8	85·0	85·1	85·2	85·3	85·5	85·6	85·7
·160	83·7	83·8	83·9	84·0	84·1	84·3	84·4	84·5	84·6	84·8	84·9	85·0	85·2	85·3	85·4
·170	83·3	83·4	83·5	83·6	83·8	83·9	84·0	84·2	84·3	84·4	84·6	84·7	84·9	85·0	85·1
·180	82·9	83·0	83·1	83·3	83·4	83·5	83·7	83·8	84·0	84·1	84·3	84·4	84·6	84·7	84·9
·190	82·5	82·6	82·8	82·9	83·0	83·2	83·3	83·5	83·6	83·8	83·9	84·1	84·3	84·4	84·6
·200	82·1	82·2	82·4	82·5	82·7	82·8	83·0	83·1	83·3	83·5	83·6	83·8	84·0	84·1	84·3
·210	81·7	81·8	82·0	82·2	82·3	82·5	82·6	82·8	83·0	83·1	83·3	83·5	83·7	83·8	84·0
·220	81·3	81·5	81·6	81·8	82·0	82·1	82·3	82·5	82·6	82·8	83·0	83·2	83·4	83·5	83·7
·230	80·9	81·1	81·3	81·4	81·6	81·8	81·9	82·1	82·3	82·5	82·7	82·9	83·1	83·2	83·4
·240	80·5	80·7	80·9	81·1	81·2	81·4	81·6	81·8	82·0	82·2	82·4	82·6	82·8	83·0	83·2
·250	80·1	80·3	80·5	80·7	80·9	81·1	81·2	81·4	81·6	81·8	82·0	82·2	82·5	82·7	82·9
·260	79·8	79·9	80·1	80·3	80·5	80·7	80·9	81·1	81·3	81·5	81·7	81·9	82·2	82·4	82·6
·270	79·4	79·6	79·8	80·0	80·2	80·4	80·6	80·8	81·0	81·2	81·4	81·6	81·9	82·1	82·3
·280	79·0	79·2	79·4	79·6	79·8	80·0	80·2	80·4	80·7	80·9	81·1	81·3	81·6	81·8	82·0
·290	78·6	78·8	79·0	79·2	79·4	79·7	79·9	80·1	80·3	80·6	80·8	81·0	81·3	81·5	81·7
·300	78·2	78·4	78·6	78·9	79·1	79·3	79·5	79·8	80·0	80·2	80·5	80·7	81·0	81·2	81·5
·310	77·8	78·1	78·3	78·5	78·7	79·0	79·2	79·4	79·7	79·9	80·2	80·4	80·7	80·9	81·2
·320	77·5	77·7	77·9	78·1	78·4	78·6	78·9	79·1	79·3	79·6	79·9	80·1	80·4	80·6	80·9
·330	77·1	77·3	77·5	77·8	78·0	78·3	78·5	78·8	79·0	79·3	79·5	79·8	80·1	80·4	80·6
·340	76·7	76·9	77·2	77·4	77·7	77·9	78·2	78·4	78·7	79·0	79·2	79·5	79·8	80·1	80·4
·350	76·3	76·6	76·8	77·1	77·3	77·6	77·8	78·1	78·4	78·6	78·9	79·2	79·5	79·8	80·1
·360	76·0	76·2	76·5	76·7	77·0	77·2	77·5	77·8	78·1	78·3	78·6	78·9	79·2	79·5	79·8
·370	75·6	75·8	76·1	76·4	76·6	76·9	77·2	77·4	77·7	78·0	78·3	78·6	78·9	79·2	79·5
·380	75·2	75·5	75·7	76·0	76·3	76·6	76·8	77·1	77·4	77·7	78·0	78·3	78·6	78·9	79·2
·390	74·8	75·1	75·4	75·6	75·9	76·2	76·5	76·8	77·1	77·4	77·7	78·0	78·3	78·6	79·0
·400	74·5	74·7	75·0	75·3	75·6	75·9	76·2	76·5	76·8	77·1	77·4	77·7	78·0	78·4	78·7
·410	74·1	74·4	74·7	74·9	75·2	75·5	75·8	76·1	76·5	76·8	77·1	77·4	77·7	78·1	78·4
·420	73·7	74·0	74·3	74·6	74·9	75·2	75·5	75·8	76·1	76·5	76·8	77·1	77·5	77·8	78·1
·430	73·4	73·7	73·9	74·2	74·5	74·9	75·2	75·5	75·8	76·1	76·5	76·8	77·2	77·5	77·9
·440	73·0	73·3	73·6	73·9	74·2	74·5	74·8	75·2	75·5	75·8	76·2	76·5	76·9	77·2	77·6
·450	72·6	72·9	73·2	73·6	73·9	74·2	74·5	74·8	75·2	75·5	75·9	76·2	76·6	77·0	77·3
·460	72·3	72·6	72·9	73·2	73·5	73·9	74·2	74·5	74·9	75·2	75·6	75·9	76·3	76·7	77·0
·470	71·9	72·2	72·5	72·9	73·2	73·5	73·9	74·2	74·6	74·9	75·3	75·6	76·0	76·4	76·8
·480	71·6	71·9	72·2	72·5	72·9	73·2	73·5	73·9	74·2	74·6	75·0	75·3	75·7	76·1	76·5
·490	71·2	71·5	71·8	72·2	72·5	72·9	73·2	73·6	73·9	74·3	74·7	75·1	75·4	75·8	76·2

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·500	70·8	71·2	71·5	71·8	72·2	72·5	72·9	73·3	73·6	74·0	74·4	74·8	75·2	75·6	76·0
·510	70·5	70·8	71·2	71·5	71·8	72·2	72·6	72·9	73·3	73·7	74·1	74·5	74·9	75·3	75·7
·520	70·1	70·5	70·8	71·2	71·5	71·9	72·2	72·6	73·0	73·4	73·8	74·2	74·6	75·0	75·4
·530	69·8	70·1	70·5	70·8	71·2	71·6	71·9	72·3	72·7	73·1	73·5	73·9	74·3	74·7	75·2
·540	69·4	69·8	70·1	70·5	70·9	71·2	71·6	72·0	72·4	72·8	73·2	73·6	74·0	74·5	74·9
·550	69·1	69·4	69·8	70·2	70·5	70·9	71·3	71·7	72·1	72·5	72·9	73·3	73·8	74·2	74·6
·560	68·7	69·1	69·5	69·8	70·2	70·6	71·0	71·4	71·8	72·2	72·6	73·0	73·5	73·9	74·4
·570	68·4	68·8	69·1	69·5	69·9	70·3	70·7	71·1	71·5	71·9	72·3	72·8	73·2	73·6	74·1
·580	68·1	68·4	68·8	69·2	69·6	69·9	70·3	70·8	71·2	71·6	72·0	72·5	72·9	73·4	73·8
·590	67·7	68·1	68·5	68·8	69·2	69·6	70·0	70·5	70·9	71·3	71·7	72·2	72·6	73·1	73·6
·600	67·4	67·7	68·1	68·5	68·9	69·3	69·7	70·1	70·6	71·0	71·5	71·9	72·4	72·8	73·3
·610	67·0	67·4	67·8	68·2	68·6	69·0	69·4	69·8	70·3	70·7	71·2	71·6	72·1	72·6	73·0
·620	66·7	67·1	67·5	67·9	68·3	68·7	69·1	69·5	70·0	70·4	70·9	71·3	71·8	72·3	72·8
·630	66·4	66·7	67·1	67·5	68·0	68·4	68·8	69·2	69·7	70·1	70·6	71·1	71·5	72·0	72·5
·640	66·0	66·4	66·8	67·2	67·6	68·1	68·5	68·9	69·4	69·8	70·3	70·8	71·3	71·8	72·3
·650	65·7	66·1	66·5	66·9	67·3	67·8	68·2	68·6	69·1	69·6	70·0	70·5	71·0	71·5	72·0
·660	65·4	65·8	66·2	66·6	67·0	67·4	67·9	68·3	68·8	69·3	69·7	70·2	70·7	71·2	71·7
·670	65·0	65·4	65·9	66·3	66·7	67·1	67·6	68·0	68·5	69·0	69·5	70·0	70·5	71·0	71·5
·680	64·7	65·1	65·5	66·0	66·4	66·8	67·3	67·7	68·2	68·7	69·2	69·7	70·2	70·7	71·2
·690	64·4	64·8	65·2	65·6	66·1	66·5	67·0	67·4	67·9	68·4	68·9	69·4	69·9	70·4	71·0
·700	64·1	64·5	64·9	65·3	65·8	66·2	66·7	67·2	67·6	68·1	68·6	69·1	69·6	70·2	70·7
·710	63·7	64·2	64·6	65·0	65·5	65·9	66·4	66·9	67·3	67·8	68·3	68·9	69·4	69·9	70·5
·720	63·4	63·8	64·3	64·7	65·2	65·6	66·1	66·6	67·1	67·6	68·1	68·6	69·1	69·7	70·2
·730	63·1	63·5	64·0	64·4	64·9	65·3	65·8	66·3	66·8	67·3	67·8	68·3	68·9	69·4	69·9
·740	62·8	63·2	63·7	64·1	64·6	65·0	65·5	66·0	66·5	67·0.	67·5	68·0	68·6	69·1	69·7
·750	62·5	62·9	63·4	63·8	64·3	64·7	65·2	65·7	66·2	66·7	67·2	67·8	68·3	68·9	69·4
·760	62·2	62·6	63·0	63·5	64·0	64·4	64·9	65·4	65·9	66·4	67·0	67·5	68·1	68·6	69·2
·770	61·9	62·3	62·7	63·2	63·7	64·1	64·6	65·1	65·6	66·2	66·7	67·2	67·8	68·4	68·9
·780	61·5	62·0	62·4	62·9	63·4	63·9	64·3	64·9	65·4	65·9	66·4	67·0	67·5	68·1	68·7
·790	61·2	61·7	62·1	62·6	63·1	63·6	64·1	64·6	65·1	65·6	66·2	66·7	67·3	67·9	68·4
·800	60·9	61·4	61·8	62·3	62·8	63·3	63·8	64·3	64·8	65·4	65·9	66·5	67·0	67·6	68·2
·810	60·6	61·1	61·5	62·0	62·5	63·0	63·5	64·0	64·5	65·1	65·6	66·2	66·8	67·4	68·0
·820	60·3	60·8	61·2	61·7	62·2	62·7	63·2	63·7	64·3	64·8	65·4	65·9	66·5	67·1	67·7
·830	60·0	60·5	61·0	61·4	61·9	62·4	62·9	63·5	64·0	64·5	65·1	65·7	66·3	66·9	67·5
·840	59·7	60·2	60·7	61·1	61·6	62·1	62·7	63·2	63·7	64·3	64·9	65·4	66·0	66·6	67·2
·850	59·4	59·9	60·4	60·9	61·3	61·9	62·4	62·9	63·5	64·0	64·6	65·2	65·8	66·4	67·0
·860	59·1	59·6	60·1	60·6	61·1	61·6	62·1	62·6	63·2	63·7	64·3	64·9	65·5	66·1	66·7
·870	58·9	59·3	59·8	60·3	60·8	61·3	61·8	62·4	62·9	63·5	64·1	64·6	65·2	65·9	66·5
·880	58·6	59·0	59·5	60·0	60·5	61·0	61·6	62·1	62·6	63·2	63·8	64·4	65·0	65·6	66·3
·890	58·3	58·7	59·2	59·7	60·2	60·7	61·3	61·8	62·4	63·0	63·5	64·1	64·8	65·4	66·0
·900	58·0	58·5	58·9	59·4	60·0	60·5	61·0	61·6	62·1	62·7	63·3	63·9	64·5	65·1	65·8
·910	57·7	58·2	58·7	59·2	59·7	60·2	60·7	61·3	61·9	62·4	63·0	63·6	64·3	64·9	65·5
·920	57·4	57·9	58·4	58·9	59·4	59·9	60·5	61·0	61·6	62·2	62·8	63·4	64·0	64·6	65·3
·930	57·1	57·6	58·1	58·6	59·1	59·7	60·2	60·8	61·3	61·9	62·5	63·1	63·8	64·4	65·1
·940	56·9	57·3	57·8	58·3	58·9	59·4	59·9	60·5	61·1	61·7	62·3	62·9	63·5	64·2	64·8
·950	56·6	57·1	57·6	58·1	58·6	59·1	59·7	60·2	60·8	61·4	62·0	62·6	63·3	63·9	64·6
·960	56·3	56·8	57·3	57·8	58·3	58·9	59·4	60·0	60·6	61·2	61·8	62·4	63·0	63·7	64·4
·970	56·0	56·5	57·0	57·5	58·1	58·6	59·2	59·7	60·3	60·9	61·5	62·2	62·8	63·5	64·1
·980	55·8	56·2	56·7	57·3	57·8	58·3	58·9	59·5	60·1	60·7	61·3	61·9	62·6	63·2	63·9
·990	55·5	56·0	56·5	57·0	57·5	58·1	58·6	59·2	59·8	60·4	61·0	61·7	62·3	63·0	63·7

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
	AZIMUTHS.														
′	°	°	°	°		°	°	°	°	°	°	°	°	°	°
1·00	55·2	55·7	56·2	56·7	57·3	57·8	58·4	59·0	59·6	60·2	60·8	61·4	62·1	62·7	63·4
1·02	54·7	55·2	55·7	56·2	56·7	57·3	57·9	58·5	59·1	59·7	60·3	60·9	61·6	62·3	63·0
1·04	54·2	54·7	55·2	55·7	56·2	56·8	57·4	58·0	58·6	59·2	59·8	60·5	61·1	61·8	62·5
1·06	53·6	54·1	54·7	55·2	55·7	56·3	56·9	57·5	58·1	58·7	59·3	60·0	60·7	61·4	62·1
1·08	53·1	53·6	54·1	54·7	55·2	55·8	56·4	57·0	57·6	58·2	58·9	59·5	60·2	60·9	61·6
1·10	52·6	53·1	53·6	54·2	54·7	55·3	55·9	56·5	57·1	57·8	58·4	59·1	59·8	60·5	61·2
1·12	52·1	52·6	53·2	53·7	54·2	54·8	55·4	56·0	56·6	57·3	57·9	58·6	59·3	60·0	60·8
1·14	51·6	52·1	52·7	53·2	53·8	54·3	54·9	55·5	56·2	56·8	57·5	58·2	58·9	59·6	60·3
1·16	51·1	51·7	52·2	52·7	53·3	53·9	54·5	55·1	55·7	56·4	57·0	57·7	58·4	59·1	59·9
1·18	50·7	51·2	51·7	52·3	52·8	53·4	54·0	54·6	55·3	55·9	56·6	57·3	58·0	58·7	59·5
1·20	50·2	50·7	51·2	51·8	52·4	52·9	53·5	54·2	54·8	55·5	56·1	56·8	57·5	58·3	59·0
1·22	49·7	50·2	50·8	51·3	51·9	52·5	53·1	53·7	54·4	55·0	55·7	56·4	57·1	57·9	58·6
1·24	49·3	49·8	50·3	50·9	51·4	52·0	52·6	53·3	53·9	54·6	55·3	56·0	56·7	57·4	58·2
1·26	48·8	49·3	49·9	50·4	51·0	51·6	52·2	52·8	53·5	54·1	54·8	55·5	56·3	57·0	57·8
1·28	48·4	48·9	49·4	50·0	50·6	51·1	51·8	52·4	53·0	53·7	54·4	55·1	55·9	56·6	57·4
1·30	47·9	48·4	49·0	49·5	50·1	50·7	51·3	52·0	52·6	53·3	54·0	54·7	55·4	56·2	57·0
1·32	47·5	48·0	48·5	49·1	49·7	50·3	50·9	51·5	52·2	52·9	53·6	54·3	55·0	55·8	56·6
1·34	47·1	47·6	48·1	48·7	49·3	49·9	50·5	51·1	51·8	52·5	53·2	53·9	54·6	55·4	56·2
1·36	46·6	47·2	47·7	48·3	48·8	49·4	50·1	50·7	51·4	52·0	52·7	53·5	54·2	55·0	55·8
1·38	46·2	46·7	47·3	47·8	48·4	49·0	49·6	50·3	51·0	51·6	52·3	53·1	53·8	54·6	55·4
1·40	45·8	46·3	46·9	47·4	48·0	48·6	49·2	49·9	50·5	51·2	51·9	52·7	53·4	54·2	55·0
1·42	45·4	45·9	46·5	47·0	47·6	48·2	48·8	49·5	50·1	50·8	51·5	52·3	53·0	53·8	54·6
1·44	45·0	45·5	46·1	46·6	47·2	47·8	48·4	49·1	49·8	50·4	51·2	51·9	52·7	53·4	54·2
1·46	44·6	45·1	45·7	46·2	46·8	47·4	48·0	48·7	49·4	50·1	50·8	51·5	52·3	53·1	53·9
1·48	44·2	44·7	45·3	45·8	46·4	47·0	47·7	48·3	49·0	49·7	50·4	51·1	51·9	52·7	53·5
1·50	43·8	44·3	44·9	45·5	46·0	46·7	47·3	47·9	48·6	49·3	50·0	50·8	51·5	52·3	53·1
1·52	43·4	44·0	44·5	45·1	45·7	46·3	46·9	47·5	48·2	48·9	49·6	50·4	51·1	51·9	52·8
1·54	43·1	43·6	44·1	44·7	45·3	45·9	46·5	47·2	47·8	48·5	49·3	50·0	50·8	51·6	52·4
1·56	42·7	43·2	43·8	44·3	44·9	45·5	46·2	46·8	47·5	48·2	48·9	49·6	50·4	51·2	52·0
1·58	42·3	42·9	43·4	44·0	44·6	45·2	45·8	46·4	47·1	47·8	48·5	49·3	50·1	50·9	51·7
1·60	42·0	42·5	43·0	43·6	44·2	44·8	45·4	46·1	46·8	47·5	48·2	48·9	49·7	50·5	51·3
1·62	41·6	42·1	42·7	43·3	43·8	44·4	45·1	45·7	46·4	47·1	47·8	48·6	49·4	50·2	51·0
1·64	41·3	41·8	42·3	42·9	43·5	44·1	44·7	45·4	46·1	46·8	47·5	48·2	49·0	49·8	50·6
1·66	40·9	41·5	42·0	42·6	43·1	43·7	44·4	45·0	45·7	46·4	47·1	47·9	48·7	49·5	50·3
1·68	40·6	41·1	41·7	42·2	42·8	43·4	44·0	44·7	45·4	46·1	46·8	47·5	48·3	49·1	50·0
1·70	40·3	40·8	41·3	41·9	42·5	43·1	43·7	44·3	45·0	45·7	46·4	47·2	48·0	48·8	49·6
1·72	39·9	40·4	41·0	41·5	42·1	42·7	43·4	44·0	44·7	45·4	46·1	46·9	47·7	48·5	49·3
1·74	39·6	40·1	40·7	41·2	41·8	42·4	43·0	43·7	44·4	45·1	45·8	46·5	47·3	48·1	49·0
1·76	39·3	39·8	40·3	40·9	41·5	42·1	42·7	43·4	44·0	44·7	45·5	46·2	47·0	47·8	48·7
1·78	39·0	39·5	40·0	40·6	41·2	41·8	42·4	43·0	43·7	44·4	45·1	45·9	46·7	47·5	48·3
1·80	38·7	39·2	39·7	40·3	40·8	41·4	42·1	42·7	43·4	44·1	44·8	45·6	46·4	47·2	48·0
1·82	38·3	38·9	39·4	39·9	40·5	41·1	41·7	42·4	43·1	43·8	44·5	45·3	46·0	46·9	47·7
1·84	38·0	38·6	39·1	39·6	40·2	40·8	41·4	42·1	42·8	43·5	44·2	44·9	45·7	46·5	47·4
1·86	37·7	38·2	38·8	39·3	39·9	40·5	41·1	41·8	42·4	43·1	43·9	44·6	45·4	46·2	47·1
1·88	37·4	38·0	38·5	39·0	39·6	40·2	40·8	41·5	42·1	42·8	43·6	44·3	45·1	45·9	46·8
1·90	37·1	37·7	38·2	38·7	39·3	39·9	40·5	41·2	41·8	42·5	43·3	44·0	44·8	45·6	46·5
1·92	36·9	37·4	37·9	38·4	39·0	39·6	40·2	40·9	41·5	42·2	43·0	43·7	44·5	45·3	46·2
1·94	36·6	37·1	37·6	38·2	38·7	39·3	39·9	40·6	41·2	41·9	42·7	43·4	44·2	45·0	45·9
1·96	36·3	36·8	37·3	37·9	38·4	39·0	39·6	40·3	41·0	41·7	42·4	43·1	43·9	44·7	45·6
1·98	36·0	36·5	37·0	37·6	38·2	38·7	39·4	40·0	40·7	41·4	42·1	42·8	43·6	44·4	45·3

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
2·00	35·7	36·2	36·8	37·3	37·9	38·5	39·1	39·7	40·4	41·1	41·8	42·6	43·3	44·2	45·0
2·05	35·1	35·6	36·1	36·6	37·2	37·8	38·4	39·0	39·7	40·4	41·1	41·8	42·6	43·4	44·3
2·10	34·4	34·9	35·4	36·0	36·5	37·1	37·7	38·4	39·0	39·7	40·4	41·2	41·9	42·8	43·6
2·15	33·8	34·3	34·8	35·3	35·9	36·5	37·1	37·7	38·4	39·0	39·8	40·5	41·3	42·1	42·9
2·20	33·2	33·7	34·2	34·7	35·3	35·8	36·4	37·1	37·7	38·4	39·1	39·8	40·6	41·4	42·3
2·25	32·6	33·1	33·6	34·1	34·7	35·2	35·8	36·4	37·1	37·8	38·5	39·2	40·0	40·8	41·6
2·30	32·0	32·5	33·0	33·5	34·1	34·6	35·2	35·8	36·5	37·2	37·9	38·6	39·4	40·2	41·0
2·40	31·0	31·4	31·9	32·4	33·0	33·5	34·1	34·7	35·3	36·0	36·7	37·4	38·2	39·0	39·8
2·50	29·9	30·4	30·9	31·4	31·9	32·4	33·0	33·6	34·2	34·9	35·6	36·3	37·0	37·8	38·7
2·60	29·0	29·4	29·9	30·4	30·9	31·4	32·0	32·6	33·2	33·8	34·5	35·2	36·0	36·8	37·6
2·70	28·1	28·5	29·0	29·4	30·0	30·5	31·0	31·6	32·2	32·9	33·5	34·2	35·0	35·7	36·5
2·80	27·2	27·6	28·1	28·6	29·1	29·6	30·1	30·7	31·3	31·9	32·6	33·3	34·0	34·7	35·5
2·90	26·4	26·8	27·3	27·7	28·2	28·7	29·3	29·8	30·4	31·0	31·7	32·3	33·1	33·8	34·6
3·00	25·6	26·0	26·5	26·9	27·4	27·9	28·4	29·0	29·6	30·2	30·8	31·5	32·2	32·9	33·7
3·10	24·9	25·3	25·7	26·2	26·6	27·1	27·7	28·2	28·8	29·4	30·0	30·6	31·3	32·1	32·8
3·20	24·2	24·6	25·0	25·5	25·9	26·4	26·9	27·4	28·0	28·6	29·2	29·8	30·5	31·2	32·0
3·30	23·6	24·0	24·4	24·8	25·2	25·7	26·2	26·7	27·3	27·8	28·5	29·1	29·8	30·5	31·2
3·40	22·9	23·3	23·7	24·1	24·6	25·0	25·5	26·0	26·6	27·1	27·7	28·4	29·0	29·7	30·5
3·60	21·8	22·2	22·5	22·9	23·4	23·8	24·3	24·8	25·3	25·8	26·4	27·0	27·7	28·3	29·1
3·80	20·7	21·1	21·5	21·9	22·3	22·7	23·1	23·6	24·1	24·6	25·2	25·8	26·4	27·1	27·8
4·00	19·8	20·1	20·5	20·9	21·3	21·7	22·1	22·6	23·0	23·6	24·1	24·7	25·3	25·9	26·6
4·20	18·9	19·2	19·6	19·9	20·3	20·7	21·1	21·6	22·1	22·5	23·1	23·6	24·2	24·8	24·5
4·40	18·1	18·4	18·8	19·1	19·5	19·9	20 3	20 7	21·1	21·6	22·1	22·7	23·2	23·8	24·4
4·60	17·4	17·7	18·0	18·3	18·7	19·1	19·4	19·9	20 3	20·8	21·2	21·8	22·3	22·9	23·5
4·80	16·7	17·0	17·3	17·6	18·0	18·3	18·7	19·1	19·5	20·0	20·4	20·9	21·5	22·0	22·6
5·00	16·1	16·3	16·6	17·0	17·3	17·6	18·0	18·4	18·8	19·2	19·7	20·2	20·7	21·2	21·8
5·50	14·7	14·9	15·2	15·5	15·8	16·1	16·5	16·8	17·2	17·6	18·0	18·5	18·9	19·4	20·0
6·00	13·5	13·7	14·0	14·3	14·5	14·8	15·1	15·5	15·8	16·2	16·6	17·0	17·5	17·9	18·4
6·50	12·5	12·7	12·9	13·2	13·5	13·7	14·0	14·3	14·7	15·0	15·4	15·8	16·2	16·6	17·1
7·00	11·6	11·8	12·1	12·3	12·5	12·8	13·1	13·4	13·7	14·0	14·3	14·7	15·1	15·5	15·9
8·0	10·2	10·4	10·6	10·8	11·0	11·2	11·5	11·7	12·0	12·3	12·6	12·9	13·3	13·6	14·0
9·0	9·1	9·3	9·4	9·6	9·8	10·0	10·2	10·5	10·7	11·0	11·2	11·5	11·8	12·2	12·5
10·0	8·2	8·3	8·5	8·7	8·8	9·0	9·2	9·4	9·7	9·9	10·1	10·4	10·7	11·0	11·3
11·0	7·5	7·6	7·7	7·9	8·0	8·2	8·4	8·6	8·8	9·0	9·2	9·5	9·7	10·0	10·3
12·0	6·8	7·0	7·1	7·2	7·4	7·5	7·7	7·9	8·1	8·3	8·5	8·7	8·9	9·2	9·5
13·0	6·3	6·4	6·6	6·7	6·8	7·0	7·1	7·3	7·5	7·6	7·8	8·0	8·3	8·5	8·7
15·0	5·5	5·6	5·7	5·8	5·9	6·0	6·2	6·3	6·5	6·6	6·8	7·0	7·2	7·4	7·6
17·0	4·8	4·9	5·0	5·1	5·2	5·3	5·5	5·6	5·7	5·9	6·0	6·2	6·3	6·5	6·7
20·0	4·1	4·2	4·3	4·4	4·4	4·5	4·6	4·7	4·9	5·0	5·1	5·2	5·4	5·5	5·7
25·0	3·3	3·4	3·4	3·5	3·6	3·6	3·7	3·8	3·9	4·0	4·1	4·2	4·3	4 4	4·6
30·0	2·7	2·8	2·9	2·9	3·0	3·0	3·1	3·2	3·2	3·3	3·4	3·5	3·6	3·7	3·8
40·0	2·1	2·1	2·1	2·2	2·2	2·3	2·3	2·4	2·4	2·5	2·6	2·6	2·7	2·8	2·9
50·0	1·6	1·7	1·7	1·7	1·8	1·8	1·9	1·9	1·9	2·0	2·0	2·1	2·2	2·2	2·3
70·0	1·2	1·2	1·2	1·2	1·3	1·3	1·3	1·4	1·4	1·4	1·5	1·5	1·5	1·6	1·6
100·0	0·8	0·8	0·9	0·9	0·9	0·9	0·9	1·0	1·0	1·0	1·0	1·1	1·1	1·1	1·1
150·0	0·5	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·6	0·7	0·7	0·7	0·7	0·7	0·8
200·0	0·4	0·4	0·4	0·4	0·4	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·6	0·6
300·0	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·4	0·4	0·4	0·4
400·0	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·3	0·3	0·3	0·3	0·3
800·0	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	61°	62°	63°	64°	65°	66°	67°	68°	69°	69½°	70°	70½°	71°	71½°	72°
	AZIMUTHS														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·00	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0
·01	89·7	89·7	89·7	89·7	89·8	89·8	89·8	89·8	89·8	89·8	89·8	89·8	89·8	89·8	89·8
·02	89·4	89·5	89·5	89·5	89·5	89·5	89·6	89·6	89·6	89·6	89·6	89·6	89·6	89·6	89·6
·03	89·2	89·2	89·2	89·2	89·3	89·3	89·3	89·4	89·4	89·4	89·4	89·4	89·4	89·5	89·5
·04	88·9	88·9	89·0	89·0	89·0	89·1	89·1	89·1	89·2	89·2	89·2	89·2	89·3	89·3	89·3
·05	88·6	88·7	88·7	88·7	88·8	88·8	88·9	88·9	89·0	89·0	89·0	89·0	89·1	89·1	89·1
·06	88·3	88·4	88·4	88·5	88·5	88·6	88·7	88·7	88·8	88·8	88·8	88·9	88·9	88·9	88·9
·07	88·1	88·1	88·2	88·2	88·3	88·4	88·4	88·5	88·6	88·6	88·6	88·7	88·7	88·7	88·8
·08	87·8	87·8	87·9	88·0	88·1	88·1	88·2	88·3	88·4	88·4	88·4	88·5	88·5	88·5	88·6
·09	87·5	87·6	87·7	87·7	87·8	87·9	88·0	88·1	88·2	88·2	88·2	88·3	88·3	88·4	88·4
·10	87·2	87·3	87·4	87·5	87·6	87·7	87·8	87·9	87·9	88·0	88·0	88·1	88·1	88·2	88·2
·11	86·9	87·0	87·1	87·2	87·3	87·4	87·5	87·6	87·7	87·8	87·8	87·9	87·9	88·0	88·1
·12	86·7	86·8	86·9	87·0	87·1	87·2	87·3	87·4	87·5	87·6	87·6	87·7	87·8	87·8	87·9
·13	86·4	86·5	86·6	86·7	86·9	87·0	87·1	87·2	87·3	87·4	87·5	87·5	87·6	87·6	87·7
·14	86·1	86·2	86·4	86·5	86·6	86·7	86·9	87·0	87·1	87·2	87·3	87·3	87·4	87·5	87·5
·15	85·8	86·0	86·1	86·2	86·4	86·5	86·6	86·8	86·9	87·0	87·1	87·1	87·2	87·3	87·3
·16	85·6	85·7	85·8	86·0	86·1	86·3	86·4	86·6	86·7	86·8	86·9	86·9	87·0	87·1	87·2
·17	85·3	85·4	85·6	85·7	85·9	86·0	86·2	86·4	86·5	86·6	86·7	86·8	86·8	86·9	87·0
·18	85·0	85·2	85·3	85·5	85·6	85·8	86·0	86·1	86·3	86·4	86·5	86·6	86·6	86·7	86·8
·19	84·7	84·9	85·1	85·2	85·4	85·6	85·8	85·9	86·1	86·2	86·3	86·4	86·5	86·5	86·6
·20	84·5	84·6	84·8	85·0	85·2	85·3	85·5	85·7	85·9	86·0	86·1	86·2	86·3	86·4	86·5
·21	84·2	84·4	84·6	84·7	84·9	85·1	85·3	85·5	85·7	85·8	85·9	86·0	86·1	86·2	86·3
·22	83·9	84·1	84·3	84·5	84·7	84·9	85·1	85·3	85·5	85·6	85·7	85·8	85·9	86·0	86·1
·23	83·6	83·8	84·0	84·2	84·4	84·7	84·9	85·1	85·3	85·4	85·5	85·6	85·7	85·8	85·9
·24	83·4	83·6	83·8	84·0	84·2	84·4	84·6	84·9	85·1	85·2	85·3	85·4	85·5	85·6	85·8
·25	83·1	83·3	83·5	83·7	84·0	84·2	84·4	84·6	84·9	85·0	85·1	85·2	85·3	85·5	85·6
·26	82·8	83·0	83·3	83·5	83·7	84·0	84·2	84·4	84·7	84·8	84·9	85·0	85·2	85·3	85·4
·27	82·5	82·8	83·0	83·2	83·5	83·7	84·0	84·2	84·5	84·6	84·7	84·8	85·0	85·1	85·2
·28	82·3	82·5	82·8	83·0	83·3	83·5	83·8	84·0	84·3	84·4	84·5	84·7	84·8	84·9	85·1
·29	82·0	82·2	82·5	82·8	83·0	83·3	83·5	83·8	84·1	84·2	84·3	84·5	84·6	84·7	84·9
·30	81·7	82·0	82·2	82·5	82·8	83·0	83·3	83·6	83·9	84·0	84·1	84·3	84·4	84·6	84·7
·31	81·5	81·7	82·0	82·3	82·5	82·8	83·1	83·4	83·7	83·8	83·9	84·1	84·2	84·4	84·5
·32	81·2	81·5	81·7	82·0	82·3	82·6	82·9	83·2	83·5	83·6	83·8	83·9	84·1	84·2	84·4
·33	80·9	81·2	81·5	81·8	82·1	82·4	82·7	83·0	83·3	83·4	83·6	83·7	83·9	84·0	84·2
·34	80·6	80·9	81·2	81·5	81·8	82·1	82·4	82·7	83·1	83·2	83·4	83·5	83·7	83·8	84·0
·35	80·4	80·7	81·0	81·3	81·6	81·9	82·2	82·5	82·9	83·0	83·2	83·3	83·5	83·7	83·8
·36	80·1	80·4	80·7	81·0	81·3	81·7	82·0	82·3	82·6	82·8	83·0	83·1	83·3	83·5	83·7
·37	79·8	80·1	80·5	80·8	81·1	81·4	81·8	82·1	82·4	82·6	82·8	83·0	83·1	83·3	83·5
·38	79·6	79·9	80·2	80·5	80·9	81·2	81·6	81·9	82·2	82·4	82·6	82·8	82·9	83·1	83·3
·39	79·3	79·6	80·0	80·3	80·6	81·0	81·3	81·7	82·0	82·2	82·4	82·6	82·8	82·9	83·1
·40	79·0	79·4	79·7	80·1	80·4	80·8	81·1	81·5	81·8	82·0	82·2	82·4	82·6	82·8	83·0
·41	78·8	79·1	79·5	79·8	80·2	80·5	80·9	81·3	81·6	81·8	82·0	82·2	82·4	82·6	82·8
·42	78·5	78·8	79·2	79·6	79·9	80·3	80·7	81·1	81·4	81·6	81·8	82·0	82·2	82·4	82·6
·43	78·2	78·6	79·0	79·3	79·7	80·1	80·5	80·8	81·2	81·4	81·6	81·8	82·0	82·2	82·4
·44	78·0	78·3	78·7	79·1	79·5	79·9	80·2	80·6	81·0	81·2	81·4	81·6	81·8	82·1	82·3
·45	77·7	78·1	78·5	78·8	79·2	79·6	80·0	80·4	80·8	81·0	81·3	81·5	81·7	81·9	82·1
·46	77·4	77·8	78·2	78·6	79·0	79·4	79·8	80·2	80·6	80·8	81·1	81·3	81·5	81·7	81·9
·47	77·2	77·6	78·0	78·4	78·8	79·2	79·6	80·0	80·4	80·7	80·9	81·1	81·3	81·5	81·7
·48	76·9	77·3	77·7	78·1	78·5	79·0	79·4	79·8	80·2	80·5	80·7	80·9	81·1	81·3	81·6
·49	76·6	77·0	77·5	77·9	78·3	78·7	79·2	79·6	80·0	80·3	80·5	80·7	80·9	81·2	81·4
·50	76·4	76·8	77·2	77·6	78·1	78·5	78·9	79·4	79·8	80·1	80·3	80·5	80·8	81·0	81·2
·51	76·1	76·5	77·0	77·4	77·8	78·3	78·7	79·2	79·6	79·9	80·1	80·3	80·6	80·8	81·0
·52	75·9	76·3	76·7	77·2	77·6	78·1	78·5	79·0	79·4	79·7	79·9	80·2	80·4	80·6	80·9
·53	75·6	76·0	76·5	76·9	77·4	77·8	78·3	78·8	79·2	79·5	79·7	80·0	80·2	80·5	80·7
·54	75·3	75·8	76·2	76·7	77·1	77·6	78·1	78·6	79·0	79·3	79·5	79·8	80·0	80·3	80·5

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	61°	62°	63°	64°	65°	66°	67°	68°	69°	69½°	70°	70½°	71°	71½°	72°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·55	75·1	75·5	76·0	76·4	76·9	77·4	77·9	78·4	78·8	79·1	79·3	79·6	79·8	80·1	80·4
·56	74·8	75·3	75·7	76·2	76·7	77·2	77·7	78·2	78·7	78·9	79·2	79·4	79·7	79·9	80·2
·57	74·6	75·0	75·5	76·0	76·5	76·9	77·4	77·9	78·5	78·7	79·0	79·2	79·5	79·7	80·0
·58	74·3	74·8	75·2	75·7	76·2	76·7	77·2	77·7	78·3	78·5	78·8	79·0	79·3	79·6	79·8
·59	74·0	74·5	75·0	75·5	76·0	76·5	77·0	77·5	78·1	78·3	78·6	78·9	79·1	79·4	79·7
·60	73·8	74·3	74·8	75·3	75·8	76·3	76·8	77·3	77·9	78·1	78·4	78·7	78·9	79·2	79·5
·61	73·5	74·0	74·5	75·0	75·5	76·1	76·6	77·1	77·7	77·9	78·2	78·5	78·8	79·0	79·3
·62	73·3	73·8	74·3	74·8	75·3	75·8	76·4	76·9	77·5	77·7	78·0	78·3	78·6	78·9	79·2
·63	73·0	73·5	74·0	74·6	75·1	75·6	76·2	76·7	77·3	77·6	77·8	78·1	78·4	77·7	79·0
·64	72·8	73·3	73·8	74·3	74·9	75·4	76·0	76·5	77·1	77·4	77·7	77·9	78·2	78·5	78·8
·65	72·5	73·0	73·6	74·1	74·6	75·2	75·7	76·3	76·9	77·2	77·5	77·8	78·1	78·3	78·6
·66	72·3	72·8	73·3	73·9	74·4	75·0	75·5	76·1	76·7	77·0	77·3	77·6	77·9	78·2	78·5
·67	72·0	72·5	73·1	73·6	74·2	74·8	75·3	75·9	76·5	76·8	77·1	77·4	77·7	78·0	78·3
·68	71·8	72·3	72·8	73·4	74·0	74·5	75·1	75·7	76·3	76·6	76·9	77·2	77·5	77·8	78·1
·69	71·5	72·1	72·6	73·2	73·7	74·3	74·9	75·5	76·1	76·4	76·7	77·0	77·3	77·7	78·0
·70	71·3	71·8	72·4	72·9	73·5	74·1	74·7	75·3	75·9	76·2	76·5	76·8	77·2	77·5	77·8
·71	71·0	71·6	72·1	72·7	73·3	73·9	74·5	75·1	75·7	76·0	76·4	76·7	77·0	77·3	77·6
·72	70·8	71·3	71·9	72·5	73·1	73·7	74·3	74·9	75·5	75·8	76·2	76·5	76·8	77·1	77·5
·73	70·5	71·1	71·7	72·3	72·9	73·5	74·1	74·7	75·3	75·7	76·0	76·3	76·6	77·0	77·3
·74	70·3	70·8	71·4	72·0	72·6	73·2	73·9	74·5	75·1	75·5	75·8	76·1	76·5	76·8	77·1
·75	70·0	70·6	71·2	71·8	72·4	73·0	73·7	74·3	75·0	75·3	75·6	75·9	76·3	76·6	77·0
·76	69·8	70·4	71·0	71·6	72·2	72·8	73·5	74·1	74·8	75·1	75·4	75·8	76·1	76·4	76·8
·77	69·5	70·1	70·7	71·3	72·0	72·6	73·3	73·9	74·6	74·9	75·2	75·6	75·9	76·3	76·6
·78	69·3	69·9	70·5	71·1	71·8	72·4	73·1	73·7	74·4	74·7	75·1	75·4	75·8	76·1	76·4
·79	69·0	69·7	70·3	70·9	71·5	72·2	72·8	73·5	74·2	74·5	74·9	75·2	75·6	75·9	76·3
·80	68·8	69·4	70·0	70·7	71·3	72·0	72·6	73·3	74·0	74·3	74·7	75·0	75·4	75·8	76·1
·81	68·6	69·2	69·8	70·5	71·1	71·8	72·4	73·1	73·8	74·2	74·5	74·9	75·2	75·6	75·9
·82	68·3	68·9	69·6	70·2	70·9	71·6	72·2	72·9	73·6	74·0	74·3	74·7	75·1	75·4	75·8
·83	68·1	68·7	69·4	70·0	70·7	71·3	72·0	72·7	73·4	73·8	74·2	74·5	74·9	75·2	75·6
·84	67·8	68·5	69·1	69·8	70·5	71·1	71·8	72·5	73·2	73·6	74·0	74·3	74·7	75·1	75·4
·85	67·6	68·2	68·9	69·6	70·2	70·9	71·6	72·3	73·1	73·4	73·8	74·2	74·5	74·9	75·3
·86	67·4	68·0	68·7	69·3	70·0	70·7	71·4	72·1	72·9	73·2	73·6	74·0	74·4	74·7	75·1
·87	67·1	67·8	68·4	69·1	69·8	70·5	71·2	71·9	72·7	73·1	73·4	73·8	74·2	74·6	75·0
·88	66·9	67·6	68·2	68·9	69·6	70·3	71·0	71·8	72·5	72·9	73·2	73·6	74·0	74·4	74·8
·89	66·7	67·3	68·0	68·7	69·4	70·1	70·8	71·6	72·3	72·7	73·1	73·5	73·8	74·2	74·6
·90	66·4	67·1	67·8	68·5	69·2	69·9	70·6	71·4	72·1	72·5	72·9	73·3	73·7	74·1	74·5
·91	66·2	66·9	67·6	68·3	69·0	69·7	70·4	71·2	71·9	72·3	72·7	73·1	73·5	73·9	74·3
·92	66·0	66·6	67·3	68·0	68·8	69·5	70·2	71·0	71·8	72·1	72·5	72·9	73·3	73·7	74·1
·93	65·7	66·4	67·1	67·8	68·5	69·3	70·0	70·8	71·6	72·0	72·4	72·8	73·2	73·6	74·0
·94	65·5	66·2	66·9	67·6	68·3	69·1	69·8	70·6	71·4	71·8	72·2	72·6	73·0	73·4	73·8
·95	65·3	66·0	66·7	67·4	68·1	68·9	69·6	70·4	71·2	71·6	72·0	72·4	72·8	73·2	73·6
·96	65·0	65·7	66·5	67·2	67·9	68·7	69·4	70·2	71·0	71·4	71·8	72·2	72·6	73·1	73·5
·97	64·8	65·5	66·2	67·0	67·7	68·5	69·2	70·0	70·8	71·2	71·6	72·1	72·5	72·9	73·3
·98	64·6	65·3	66·0	66·8	67·5	68·3	69·0	69·8	70·6	71·1	71·5	71·9	72·3	72·7	73·2
·99	64·4	65·1	65·8	66·5	67·3	68·1	68·9	69·7	70·5	70·9	71·3	71·7	72·1	72·6	73·0
1·00	64·1	64·9	65·6	66·3	67·1	67·9	68·7	69·5	70·3	70·7	71·1	71·5	72·0	72·4	72·8
1·02	63·7	64·4	65·2	65·9	66·7	67·5	68·3	69·1	69·9	70·3	70·8	71·2	71·6	72·1	72·5
1·04	63·2	64·0	64·7	65·5	66·3	67·1	67·9	68·7	69·6	70·0	70·4	70·9	71·3	71·7	72·2
1·06	62·8	63·5	64·3	65·1	65·9	66·7	67·5	68·3	69·2	69·6	70·1	70·5	71·0	71·4	71·9
1·08	62·4	63·1	63·9	64·7	65·5	66·3	67·1	68·0	68·8	69·3	69·7	70·2	70·6	71·1	71·5
1·10	61·9	62·7	63·5	64·3	65·1	65·9	66·7	67·6	68·5	68·9	69·4	69·8	70·3	70·8	71·2
1·12	61·5	62·3	63·0	63·9	64·7	65·5	66·4	67·2	68·1	68·6	69·0	69·5	70·0	70·4	70·9
1·14	61·1	61·8	62·6	63·4	64·3	65·1	66·0	66·9	67·8	68·2	68·7	69·2	69·6	70·1	70·6
1·16	60·6	61·4	62·2	63·0	63·9	64·7	65·6	66·5	67·4	67·9	68·4	68·8	69·3	69·8	70·3
1·18	60·2	61·0	61·8	62·6	63·5	64·4	65·2	66·2	67·1	67·5	68·0	68·5	69·0	69·5	70·0

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	61°	62°	63°	64°	65°	66°	67°	68°	69°	69½°	70°	70½°	71°	71½°	72°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1′20	59·8	60·6	61·4	62·3	63·1	64·0	64·9	65·8	66·7	67·2	67·7	68·2	68·7	69·2	69·7
1′22	59·4	60·2	61·0	61·9	62·7	63·6	64·5	65·4	66·4	66·9	67·4	67·8	68·3	68·8	69·3
1′24	59·0	59·8	60·6	61·5	62·3	63·2	64·1	65·1	66·0	66·5	67·0	67·5	68·0	68·5	69·0
1′26	58·6	59·4	60·2	61·1	62·0	62·9	63·8	64·7	65·7	66·2	66·7	67·2	67·7	68·2	68·7
1′28	58·2	59·0	59·8	60·7	61·6	62·5	63·4	64·4	65·4	65·9	66·4	66·9	67·4	67·9	68·4
1′30	57·8	58·6	59·5	60·3	61·2	62·1	63·1	64·0	65·0	65·5	66·0	66·5	67·1	67·6	68·1
1′32	57·4	58·2	59·1	59·9	60·8	61·8	62·7	63·7	64·7	65·2	65·7	66·2	66·7	67·3	67·8
1′34	57·0	57·8	58 7	59·6	60·5	61·4	62·4	63·3	64·3	64·9	65·4	65·9	66·4	67·0	67·5
1′36	56·6	57·4	58·3	59·2	60·1	61·1	62·0	63·0	64·0	64·5	65·1	65·6	66·1	66·7	67·2
1′38	56·2	57·1	57·9	58·8	59·7	60·7	61·7	62·7	63·7	64·2	64·7	65·3	65·8	66·4	66·9
1′40	55·8	56·7	57·6	58·5	59·4	60·3	61·3	62·3	63·4	63·9	64·4	65·0	65·5	66·0	66·6
1′42	55·5	56·3	57·2	58·1	59·0	60·0	61·0	62·0	63·0	63·6	64·1	64·6	65·2	65·7	66·3
1′44	55·1	55·9	56·8	57·7	58·7	59·6	60·6	61·7	62·7	63·2	63·8	64·3	64·9	65·4	66·0
1′46	54·7	55·6	56·5	57·4	58·3	59·3	60·3	61·3	62·4	62·9	63·5	64·0	64·6	65·1	65·7
1′48	54·3	55·2	56·1	57·0	58·0	59·0	60·0	61·0	62·1	62·6	63·2	63·7	64·3	64·8	65·4
1′50	54·0	54·8	55·7	56·7	57·6	58·6	59·6	60·7	61·7	62·3	62·8	63·4	64·0	64·5	65·1
1′52	53·6	54·5	55·4	56·3	57·3	58·3	59·3	60·3	61·4	62·0	62·5	63·1	63·7	64·3	64·8
1′54	53·3	54·1	55·0	56·0	56·9	57·9	59·0	60·0	61·1	61·7	62·2	62·8	63·4	64·0	64·6
1′56	52·9	53·8	54·7	55·6	56·6	57·6	58·6	59·7	60·8	61·4	61·9	62·5	63·1	63·7	64·3
1′58	52·5	53·4	54·3	55·3	56·3	57·3	58·3	59·4	60·5	61·0	61·6	62·2	62·8	63·4	64·0
1′60	52·2	53·1	54·0	55·0	55·9	56·9	58·0	59·1	60·2	60·7	61·3	61·9	62·5	63·1	63·7
1′62	51·9	52·7	53·7	54·6	55·6	56·6	57·7	58·7	59·9	60·4	61·0	61·6	62·2	62·8	63·4
1′64	51·5	52·4	53·3	54·3	55·3	56·3	57·3	58·4	59·6	60·1	60·7	61·3	61·9	62·5	63·1
1′66	51·2	52·1	53·0	54·0	54·9	56·0	57·0	58·1	59·3	59·8	60·4	61·0	61·6	62·2	62·8
1′68	50·8	51·7	52·7	53·6	54·6	55·7	56·7	57·8	58·9	59·5	60·1	60·7	61·3	61·9	62·6
1′70	50·5	51·4	52·3	53·3	54·3	55·3	56·4	57·5	58·6	59·2	59·8	60·4	61·0	61·7	62·3
1′72	50·2	51·1	52·0	53·0	54·0	55·0	56·1	57·2	58·4	58·9	59·5	60·1	60·8	61·4	62·0
1′74	49·9	50·8	51·7	52·7	53·7	54·7	55·8	56·9	58·1	58·6	59·2	59·9	60·5	61·1	61·7
1′76	49·5	50·4	51·4	52·3	53·4	54·4	55·5	56·6	57·8	58·4	59·0	59·6	60·2	60·8	61·5
1′78	49·2	50·1	51·1	52·0	53·0	54·1	55·2	56·3	57·5	58·1	58·7	59·3	59·9	60·5	61·2
1′80	48·9	49·8	50·7	51·7	52·7	53·8	54·9	56·0	57·2	57·8	58·4	59·0	59·6	60·3	60·9
1′82	48·6	49·5	50·4	51·4	52·4	53·5	54·6	55·7	56·9	57·5	58·1	58·7	59·4	60·0	60·6
1′84	48·3	49·2	50·1	51·1	52·1	53·2	54·3	55·4	56·6	57·2	57·8	58·4	59·1	59·7	60·4
1′86	48·0	48·9	49·8	50·8	51·8	52·9	54·0	55·1	56·3	56·9	57·5	58·2	58·8	59·5	60·1
1′88	47·7	48·6	49·5	50·5	51·5	52·6	53·7	54·8	56·0	56·6	57·3	57·9	58·5	59·2	59·8
1′90	47·4	48·3	49·2	50·2	51·2	52·3	53·4	54·6	55·7	56·4	57·0	57·6	58·3	58·9	59·6
1′92	47·1	48·0	48·9	49·9	50·9	52·0	53·1	54·3	55·5	56·1	56·7	57·3	58·0	58·6	59·3
1′94	46·8	47·7	48·6	49·6	50·7	51·7	52·8	54·0	55·2	55·8	56·4	57·1	57·7	58·4	59·1
1′96	46·5	47·4	48·3	49·3	50·4	51·4	52·6	53·7	54·9	55·5	56·2	56·8	57·5	58·1	58·8
1′98	46·2	47·1	48·0	49·0	50·1	51·2	52·3	53·4	54·6	55·3	55·9	56·5	57·2	57·9	58·5
2′00	45·9	46·8	47·8	48·8	49·8	50·9	52·0	53·2	54·4	55·0	55·6	56·3	56·9	57·6	58·3
2′05	45·2	46·1	47·1	48·1	49·1	50·2	51·3	52·5	53·7	54·3	55·0	55·6	56·3	57·0	57·6
2′10	44·5	45·4	46·4	47·4	48·4	49·5	50·6	51·8	53·0	53·7	54·3	55·0	55·6	56·3	57·0
2′15	43·8	44·7	45·7	46·7	47·7	48·8	50·0	51·2	52·4	53·0	53·7	54·3	55·0	55·7	56·4
2′20	43·2	44·1	45·0	46·0	47·1	48·2	49·3	50·5	51·7	52·4	53·0	53·7	54·4	55·1	55·8
2′25	42·5	43·4	44·4	45·4	46·4	47·5	48·7	49·9	51·1	51·8	52·4	53·1	53·8	54·5	55·2
2′30	41·9	42·8	43·8	44·8	45·8	46·9	48·1	49·3	50·5	51·1	51·8	52·5	53·2	53·9	54·6
2′40	40·7	41·6	42·5	43·5	44·6	45·7	46·8	48·0	49·3	50·0	50·6	51·3	52·0	52·7	53·4
2′50	39·5	40·4	41·4	42·4	43·4	44·5	45·7	46·9	48·1	48·8	49·5	50·2	50·9	51·6	52·3
2′60	38·4	39·3	40·3	41·3	42·3	43·4	44·5	45·8	47·0	47·7	48·4	49·0	49·8	50·5	51·2
2′70	37·4	38·3	39·2	40·2	41·2	42·3	43·5	44·7	45·9	46·6	47·3	48·0	48·7	49·4	50·2
2′80	36·4	37·3	38·2	39·2	40·2	41·3	42·4	43·6	44·9	45·6	46·2	46·9	47·6	48·4	49·1
2′90	35·4	36·3	37·2	38·2	39·2	40·3	41·4	42·6	43·9	44·6	45·2	45·9	46·6	47·4	48·1
3′00	34·5	35·4	36·3	37·2	38·3	39·3	40·5	41·7	42·9	43·6	44·3	45·0	45·7	46·4	47·2
3′10	33·6	34·5	35·4	36·3	37·4	38·4	39·5	40·7	42·0	42·6	43·3	44·0	44·7	45·5	46·2

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.															
	61°	62°	63°	64°	65°	66°	67°	68°	69°	69½°	70°	70½°	71°	71½°	72°
	AZIMUTHS.															
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
3·20	32·8	33·6	34·5	35·5	36·5	37·5	38·7	39·8	41·1	41·7	42·4	43·1	43·8	44·6	45·3
3·30	32·0	32·8	33·7	34·7	35·6	36·7	37·8	39·0	40·2	40·9	41·5	42·2	42·9	43·7	44·4
3·40	31·2	32·1	32·9	33·9	34·8	35·9	37·0	38·1	39·4	40·0	40·7	41·4	42·1	42·8	43·6
3·60	29·8	30·6	31·5	32·4	33·3	34·3	35·4	36·6	37·8	38·4	39·1	39·8	40·5	41·2	42·0
3·80	28·5	29·3	30·1	31·0	31·9	32·9	34·0	35·1	36·3	36·9	37·6	38·3	38·9	39·7	40·4
4·00	27·3	28·0	28·8	29·7	30·6	31·6	32·6	33·7	34·9	35·5	36·2	36·8	37·5	38·2	39·0
4·20	26·2	26·9	27·7	28·5	29·4	30·3	31·4	32·4	33·6	34·2	34·8	35·5	36·2	36·9	37·6
4·40	25·1	25·8	26·6	27·4	28·3	29·2	30·2	31·2	32·4	33·0	33·6	34·2	34·9	35·6	36·3
4·60	24·2	24·8	25·6	26·4	27·2	28·1	29·1	30·1	31·2	31·8	32·4	33·1	33·7	34·4	35·1
4·80	23·3	23·9	24·6	25·4	26·2	27·1	28·1	29·1	30·2	30·7	31·3	32·0	32·6	33·3	34·0
5·00	22·4	23·1	23·8	24·5	25·3	26·2	27·1	28·1	29·2	29·7	30·3	30·9	31·6	32·2	32·9
5·20	21·6	22·3	23·0	23·7	24·5	25·3	26·2	27·2	28·2	28·8	29·3	29·9	30·6	31·2	31·9
5·40	20·9	21·5	22·2	22·9	23·7	24·5	25·4	26·3	27·3	27·9	28·4	29·0	29·6	30·3	30·9
5·60	20·2	20·8	21·5	22·2	22·9	23·7	24·6	25·5	26·5	27·0	27·6	28·1	28·7	29·4	30·0
5·80	19·6	20·2	20·8	21·5	22·2	23·0	23·8	24·7	25·7	26·2	26·8	27·3	27·9	28·5	29·2
6·00	19·0	19·5	20·2	20·8	21·5	22·3	23·1	24·0	24·9	25·4	26·0	26·5	27·1	27·7	28·3
6·20	18·4	19·0	19·6	20·2	20·9	21·6	22·4	23·3	24·2	24·7	25·2	25·8	26·4	26·9	27·6
6·40	17·9	18·4	19·0	19·6	20·3	21·0	21·8	22·6	23·6	24·0	24·6	25·1	25·6	26·2	26·8
6·60	17·4	17·9	18·5	19·1	19·7	20·4	21·2	22·0	22·9	23·4	23·9	24·4	25·0	25·5	26·1
6·80	16·9	17·4	17·9	18·5	19·2	19·9	20·6	21·4	22·3	22·8	23·3	23·8	24·3	24·9	25·4
7·00	16·4	16·9	17·5	18·0	18·7	19·4	20·1	20·9	21·7	22·2	22·7	23·2	23·7	24·2	24·8
7·20	16·0	16·5	17·0	17·6	18·2	18·9	19·6	20·3	21·2	21·6	22·1	22·6	23·1	23·6	24·2
7·40	15·6	16·1	16·6	17·1	17·7	18·4	19·1	19·8	20·7	21·1	21·6	22·0	22·5	23·1	23·6
7·60	15·2	15·7	16·2	16·7	17·3	17·9	18·6	19·4	20·2	20·6	21·0	21·5	22·0	22·5	23·1
7·80	14·8	15·3	15·8	16·3	16·9	17·5	18·2	18·9	19·7	20·1	20·5	21·0	21·5	22·0	22·5
8·00	14·5	14·9	15·4	15·9	16·5	17·1	17·7	18·5	19·2	19·6	20·1	20·5	21·0	21·5	22·0
8·20	14·1	14·6	15·0	15·5	16·1	16·7	17·3	18·0	18·8	19·2	19·6	20·1	20·5	21·0	21·5
8·40	13·8	14·2	14·7	15·2	15·7	16·3	16·9	17·6	18·4	18·8	19·2	19·6	20·1	20·6	21·1
8·60	13·5	13·9	14·4	14·9	15·4	16·0	16·6	17·2	18·0	18·4	18·8	19·2	19·7	20·1	20·6
8·80	13·2	13·6	14·1	14·5	15·1	15·6	16·2	16·9	17·6	18·0	18·4	18·8	19·2	19·7	20·2
9·00	12·9	13·3	13·8	14·2	14·7	15·3	15·9	16·5	17·2	17·6	18·0	18·4	18·8	19·3	19·8
9·20	12·6	13·0	13·5	13·9	14·4	15·0	15·5	16·2	16·9	17·2	17·6	18·0	18·5	18·9	19·4
9·40	12·4	12·8	13·2	13·6	14·1	14·7	15·2	15·9	16·5	16·9	17·3	17·7	18·1	18·5	19·0
9·60	12·1	12·5	12·9	13·4	13·8	14·4	14·9	15·5	16·2	16·6	16·9	17·3	17·7	18·2	18·6
9·80	11·9	12·3	12·7	13·1	13·6	14·1	14·6	15·2	15·9	16·2	16·6	17·0	17·4	17·8	18·3
10·0	11·7	12·0	12·4	12·9	13·3	13·8	14·4	14·9	15·6	15·9	16·3	16·7	17·1	17·5	17·9
11·0	10·6	11·0	11·3	11·7	12·1	12·6	13·1	13·6	14·2	14·6	14·9	15·2	15·6	16·0	16·4
12·0	9·8	10·1	10·4	10·8	11·2	11·6	12·0	12·5	13·1	13·4	13·7	14·0	14·4	14·7	15·1
13·0	9·0	9·3	9·6	10·0	10·3	10·7	11·1	11·6	12·1	12·4	12·7	13·0	13·3	13·6	14·0
14·0	8·4	8·7	8·9	9·3	9·6	10·0	10·4	10·8	11·3	11·5	11·8	12·1	12·4	12·7	13·0
16·0	7·3	7·6	7·8	8·1	8·4	8·7	9·1	9·5	9·9	10·1	10·4	10·6	10·9	11·1	11·4
18·0	6·5	6·7	7·0	7·2	7·5	7·8	8·1	8·4	8·8	9·0	9·2	9·4	9·7	9·9	10·2
20·0	5·9	6·1	6·3	6·5	6·7	7·0	7·3	7·6	7·9	8·1	8·3	8·5	8·7	9·0	9·2
22·0	5·4	5·5	5·7	5·9	6·1	6·4	6·6	6·9	7·2	7·4	7·6	7·8	7·9	8·2	8·4
24·0	4·9	5·1	5·2	5·4	5·6	5·8	6·1	6·3	6·6	6·7	6·9	7·1	7·3	7·5	7·7
26·0	4·5	4·7	4·8	5·0	5·2	5·4	5·6	5·9	6·1	6·3	6·4	6·6	6·7	6·9	7·1
28·0	4·2	4·4	4·5	4·7	4·8	5·0	5·2	5·4	5·7	5·8	6·0	6·1	6·3	6·4	6·6
30·0	3·9	4·1	4·2	4·3	4·5	4·7	4·9	5·1	5·3	5·4	5·6	5·7	5·8	6·0	6·2
40·0	3·0	3·0	3·2	3·3	3·4	3·5	3·7	3·8	4·0	4·1	4·2	4·3	4·4	4·5	4·6
50·0	2·4	2·4	2·5	2·6	2·7	2·8	2·9	3·1	3·2	3·3	3·3	3·4	3·5	3·6	3·7
70·0	1·7	1·7	1·8	1·9	1·9	2·0	2·1	2·2	2·3	2·3	2·4	2·5	2·5	2·6	2·6
100·0	1·2	1·2	1·3	1·3	1·4	1·4	1·5	1·5	1·6	1·6	1·7	1·7	1·8	1·8	1·9
200·0	0·6	0·6	0·6	0·7	0·7	0·7	0·7	0·8	0·8	0·8	0·8	0·9	0·9	0·9	0·9
400·0	0·3	0·3	0·3	0·3	0·3	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·4	0·5	0·5
800·0	0·1	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2	0·2

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	83½°	84°	84½°	85°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
·00	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0	90·0
·02	89·7	89·7	89·7	89·7	89·7	89·8	89·8	89·8	89·8	89·8	89·9	89·9	89·9	89·9	89·9
·04	89·3	89·4	89·4	89·4	89·5	89·5	89·6	89·6	89·6	89·7	89·7	89·7	89·8	89·8	89·8
·06	89·0	89·1	89·1	89·2	89·2	89·3	89·3	89·4	89·5	89·5	89·6	89·6	89·6	89·7	89·7
·08	88·7	88·7	88·8	88·9	89·0	89·0	89·1	89·2	89·3	89·4	89·4	89·5	89·5	89·6	89·6
·10	88·3	88·4	88·5	88·6	88·7	88·8	88·9	89·0	89·1	89·2	89·3	89·4	89·4	89·5	89·5
·12	88·0	88·1	88·2	88·3	88·5	88·6	88·7	88·8	88·9	89·0	89·2	89·2	89·3	89·3	89·4
·14	87·7	87·8	87·9	88·1	88·2	88·3	88·5	88·6	88·7	88·9	89·0	89·1	89·2	89·2	89·3
·16	87·3	87·5	87·6	87·8	87·9	88·1	88·3	88·4	88·6	88·7	88·9	89·0	89·0	89·1	89·2
·18	87·0	87·2	87·3	87·5	87·7	87·9	88·0	88·2	88·4	88·6	88·7	88·8	88·9	89·0	89·1
·20	86·7	86·8	87·0	87·2	87·4	87·6	87·8	88·0	88·2	88·4	88·6	88·7	88·8	88·9	89·0
·22	86·3	86·5	86·7	87·0	87·2	87·4	87·6	87·8	88·0	88·2	88·5	88·6	88·7	88·8	88·9
·24	86·0	86·2	86·4	86·7	86·9	87·1	87·4	87·6	87·8	88·1	88·3	88·4	88·6	88·7	88·8
·26	85·7	85·9	86·2	86·4	86·7	86·9	87·2	87·4	87·7	87·9	88·2	88·3	88·4	88·6	88·7
·28	85·3	85·6	85·9	86·1	86·4	86·7	86·9	87·2	87·5	87·8	88·0	88·2	88·3	88·5	88·6
·30	85·0	85·3	85·6	85·8	86·1	86·4	86·7	87·0	87·3	87·6	87·9	88·1	88·2	88·4	88·5
·32	84·7	85·0	85·3	85·6	85·9	86·2	86·5	86·8	87·1	87·4	87·8	87·9	88·1	88·2	88·4
·34	84·3	84·6	85·0	85·3	85·6	86·0	86·3	86·6	87·0	87·3	87·6	87·8	88·0	88·1	88·3
·36	84·0	84·3	84·7	85·0	85·4	85·7	86·1	86·4	86·8	87·1	87·5	87·7	87·8	88·0	88·2
·38	83·7	84·0	84·4	84·7	85·1	85·5	85·9	86·2	86·6	87·0	87·3	87·5	87·7	87·9	88·1
·40	83·3	83·7	84·1	84·5	84·9	85·2	85·6	86·0	86·4	86·8	87·2	87·4	87·6	87·8	88·0
·42	83·0	83·4	83·8	84·2	84·6	85·0	85·4	85·8	86·2	86·7	87·1	87·3	87·5	87·7	87·9
·44	82·7	83·1	83·5	83·9	84·3	84·8	85·2	85·6	86·1	86·5	86·9	87·1	87·4	87·6	87·8
·46	82·3	82·8	83·2	83·7	84·1	84·5	85·0	85·4	85·9	86·3	86·8	87·0	87·2	87·5	87·7
·48	82·0	82·5	82·9	83·4	83·8	84·3	84·8	85·2	85·7	86·2	86·7	86·9	87·1	87·4	87·6
·50	81·7	82·2	82·6	83·1	83·6	84·1	84·6	85·0	85·5	86·0	86·5	86·8	87·0	87·3	87·5
·52	81·4	81·8	82·3	82·8	83·3	83·8	84·3	84·8	85·3	85·9	86·4	86·6	86·9	87·1	87·4
·54	81·0	81·5	82·0	82·6	83·1	83·6	84·1	84·6	85·2	85·7	86·2	86·5	86·8	87·0	87·3
·56	80·7	81·2	81·8	82·3	82·8	83·4	83·9	84·4	85·0	85·5	86·1	86·4	86·6	86·9	87·2
·58	80·4	80·9	81·5	82·0	82·6	83·1	83·7	84·2	84·8	85·4	86·0	86·2	86·5	86·8	87·1
·60	80·1	80·6	81·2	81·7	82·3	82·9	83·5	84·1	84·6	85·2	85·8	86·1	86·4	86·7	87·0
·62	79·7	80·3	80·9	81·5	82·1	82·7	83·3	83·9	84·5	85·1	85·7	86·0	86·3	86·6	86·9
·64	79·4	80·0	80·6	81·2	81·8	82·4	83·0	83·7	84·3	84·9	85·5	85·9	86·2	86·5	86·8
·66	79·1	79·7	80·3	80·9	81·6	82·2	82·8	83·5	84·1	84·8	85·4	85·7	86·1	86·4	86·7
·68	78·8	79·4	80·0	80·7	81·3	82·0	82·6	83·3	83·9	84·6	85·3	85·6	85·9	86·3	86·6
·70	78·4	79·1	79·7	80·4	81·1	81·7	82·4	83·1	83·8	84·4	85·1	85·5	85·8	86·2	86·5
·72	78·1	78·8	79·4	80·1	80·8	81·5	82·2	82·9	83·6	84·3	85·0	85·3	85·7	86·1	86·4
·74	77·8	78·5	79·2	79·9	80·5	81·3	82·0	82·7	83·4	84·1	84·8	85·2	85·6	85·9	86·3
·76	77·5	78·2	78·9	79·6	80·3	81·0	81·7	82·5	83·2	84·0	84·7	85·1	85·5	85·8	86·2
·78	77·2	77·9	78·6	79·3	80·0	80·8	81·5	82·3	83·0	83·8	84·6	85·0	85·3	85·7	86·1
·80	76·8	77·6	78·3	79·0	79·8	80·6	81·3	82·1	82·9	83·6	84·4	84·8	85·2	85·6	86·0
·82	76·5	77·3	78·0	78·8	79·5	80·3	81·1	81·9	82·7	83·5	84·3	84·7	85·1	85·5	85·9
·84	76·2	77·0	77·7	78·5	79·3	80·1	80·9	81·7	82·5	83·3	84·2	84·6	85·0	85·4	85·8
·86	75·9	76·7	77·5	78·2	79·1	79·9	80·7	81·5	82·3	83·2	84·0	84·4	84·9	85·3	85·7
·88	75·6	76·4	77·2	78·0	78·8	79·6	80·5	81·3	82·2	83·0	83·9	84·3	84·7	85·2	85·6
·90	75·3	76·1	76·9	77·7	78·6	79·4	80·3	81·1	82·0	82·9	83·7	84·2	84·6	85·1	85·5
·92	74·9	75·8	76·6	77·5	78·3	79·2	80·0	80·9	81·8	82·7	83·6	84·1	84·5	85·0	85·4
·94	74·6	75·5	76·3	77·2	78·1	78·9	79·8	80·7	81·6	82·5	83·5	83·9	84·4	84·9	85·3
·96	74·3	75·2	76·0	76·9	77·8	78·7	79·6	80·5	81·5	82·4	83·3	83·8	84·3	84·7	85·2
·98	74·0	74·9	75·8	76·7	77·6	78·5	79·4	80·3	81·3	82·2	83·2	83·7	84·2	84·6	85·1
1·00	73·7	74·6	75·5	76·4	77·3	78·3	79·2	80·1	81·1	82·1	83·1	83·5	84·0	84·5	85·0
1·02	73·4	74·3	75·2	76·1	77·1	78·0	79·0	80·0	80·9	81·9	82·9	83·4	83·9	84·4	84·9
1·04	73·1	74·0	74·9	75·9	76·8	77·8	78·8	79·8	80·8	81·8	82·8	83·3	83·8	84·3	84·8
1·06	72·8	73·7	74·7	75·6	76·6	77·6	78·6	79·6	80·6	81·6	82·6	83·2	83·7	84·2	84·7
1·08	72·5	73·4	74·4	75·4	76·3	77·3	78·4	79·4	80·4	81·5	82·5	83·0	83·6	84·1	84·6

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	73°	74°	75°	78°	77°	78°	79°	80°	81°	82°	83°	83½°	84°	84½°	85°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1·08	72·5	73·4	74·4	75·4	76·3	77·3	78·4	79·4	80·4	81·5	82·5	83·0	83·6	84·1	84·6
1·10	72·2	73·1	74·1	75·1	76·1	77·1	78·1	79·2	80·2	81·3	82·4	82·9	83·4	84·0	84·5
1·20	70·7	71·7	72·7	73·8	74·9	76·0	77·1	78·2	79·4	80·5	81·7	82·3	82·9	83·4	84·0
1·30	69·2	70·3	71·4	72·5	73·7	74·9	76·1	77·3	78·5	79·7	81·0	81·6	82·3	82·9	83·5
1·40	67·7	68·9	70·1	71·3	72·5	73·8	75·0	76·3	77·6	79·0	80·3	81·0	81·7	82·4	83·0
1·50	66·3	67·5	68·8	70·1	71·4	72·7	74·0	75·4	76·8	78·2	79·6	80·4	81·1	81·8	82·6
1·60	64·9	66·2	67·5	68·8	70·2	71·6	73·0	74·5	75·9	77·4	79·0	79·7	80·5	81·3	82·1
1·70	63·6	64·9	66·3	67·6	69·1	70·5	72·0	73·6	75·1	76·7	78·3	79·1	79·9	80·7	81·6
1·80	62·2	63·6	65·0	66·5	68·0	69·5	71·0	72·6	74·3	75·9	77·6	78·5	79·3	80·2	81·1
1·90	60·9	62·4	63·8	65·3	66·9	68·4	70·1	71·7	73·4	75·2	77·0	77·9	78·8	79·7	80·6
2·00	59·7	61·1	62·6	64·2	65·8	67·4	69·1	70·8	72·6	74·4	76·3	77·2	78·2	79·1	80·1
2·10	58·5	59·9	61·5	63·1	64·7	66·4	68·2	70·0	71·8	73·7	75·6	76·6	77·6	78·6	79·6
2·20	57·3	58·8	60·3	62·0	63·7	65·4	67·2	69·1	71·0	73·0	75·0	76·0	77·0	78·1	79·1
2·30	56·1	57·6	59·2	60·9	62·6	64·4	66·3	68·2	70·2	72·2	74·3	75·4	76·5	77·6	78·7
2·40	54·9	56·5	58·2	59·9	61·6	63·5	65·4	67·4	69·4	71·5	73·7	74·8	75·9	77·0	78·2
2·50	53·8	55·4	57·1	58·8	60·6	62·5	64·5	66·5	68·6	70·8	73·1	74·2	75·4	76·5	77·7
2·60	52·8	54·4	56·1	57·8	59·7	61·6	63·6	65·7	67·9	70·1	72·4	73·6	74·8	76·0	77·2
2·70	51·7	53·3	55·1	56·8	58·7	60·7	62·7	64·9	67·1	69·4	71·8	73·0	74·2	75·5	76·8
2·80	50·7	52·3	54·1	55·9	57·8	59·8	61·9	64·1	66·3	68·7	71·2	72·4	73·7	75·0	76·3
2·90	49·7	51·4	53·1	54·9	56·9	58·9	61·0	63·3	65·6	68·0	70·5	71·8	73·1	74·5	75·8
3·00	48·7	50·4	52·2	54·0	56·0	58·0	60·2	62·5	64·9	67·3	69·9	71·2	72·6	74·0	75·3
3·10	47·8	49·5	51·3	53·1	55·1	57·2	59·4	61·7	64·1	66·7	69·3	70·7	72·0	73·5	74·9
3·20	46·9	48·6	50·4	52·3	54·3	56·4	58·6	60·9	63·4	66·0	68·7	70·1	71·5	72·9	74·4
3·30	46·0	47·7	49·5	51·4	53·4	55·5	57·8	60·2	62·7	65·3	68·1	69·5	71·0	72·4	74·0
3·40	45·2	46·9	48·7	50·6	52·6	54·7	57·0	59·4	62·0	64·7	67·5	68·9	70·4	72·0	73·5
3·50	44·3	46·0	47·8	49·7	51·8	54·0	56·3	58·7	61·3	64·0	66·9	68·4	69·9	71·5	73·0
3·60	43·5	45·2	47·0	48·9	51·0	53·2	55·5	58·0	60·6	63·4	66·3	67·8	69·4	71·0	72·6
3·70	42·8	44·4	46·2	48·2	50·2	52·4	54·8	57·3	59·9	62·8	65·7	67·3	68·9	70·5	72·1
3·80	42·0	43·7	45·5	47·4	49·5	51·7	54·1	56·6	59·3	62·1	65·2	66·7	68·3	70·0	71·7
3·90	41·3	42·9	44·7	46·7	48·7	51·0	53·3	55·9	58·6	61·5	64·6	66·2	67·8	69·5	71·2
4·00	40·5	42·2	44·0	45·9	48·0	50·3	52·6	55·2	58·0	60·9	64·0	65·6	67·3	69·0	70·8
4·10	39·8	41·5	43·3	45·2	47·3	49·6	52·0	54·6	57·3	60·3	63·5	65·1	66·8	68·5	70·3
4·20	39·2	40·8	42·6	44·5	46·6	48·9	51·3	53·9	56·7	59·7	62·9	64·6	66·3	68·1	69·9
4·30	38·5	40·2	41·9	43·9	46·0	48·2	50·6	53·3	56·1	59·1	62·3	64·0	65·8	67·6	69·5
4·40	37·9	39·5	41·3	43·2	45·3	47·5	50·0	52·6	55·5	58·5	61·8	63·5	65·3	67·1	69·0
4·50	37·2	38·9	40·6	42·6	44·7	46·9	49·3	52·0	54·9	57·9	61·3	63·0	64·8	66·7	68·6
4·60	36·6	38·3	40·0	41·9	44·0	46·3	48·7	51·4	54·3	57·4	60·7	62·5	64·3	66·2	68·2
4·70	36·0	37·7	39·4	41·3	43·4	45·7	48·1	50·8	53·7	56·8	60·2	62·0	63·8	65·7	67·7
4·80	35·5	37·1	38·8	40·7	42·8	45·1	47·5	50·2	53·1	56·3	59·7	61·5	63·4	65·3	67·3
4·90	34·9	36·5	38·3	40·2	42·2	44·5	46·9	49·6	52·5	55·7	59·2	61·0	62·9	64·8	66·9
5·00	34·4	36·0	37·7	39·6	41·6	43·9	46·3	49·0	52·0	55·2	58·6	60·5	62·4	64·4	66·5
5·20	33·3	34·9	36·6	38·5	40·5	42·8	45·2	47·9	50·9	54·1	57·6	59·5	61·5	63·5	65·6
5·40	32·3	33·9	35·6	37·4	39·5	41·7	44·1	46·8	49·8	53·1	56·7	58·6	60·6	62·6	64·8
5·60	31·4	32·9	34·6	36·4	38·4	40·7	43·1	45·8	48·8	52·1	55·7	57·6	59·7	61·8	64·0
5·80	30·5	32·0	33·7	35·5	37·5	39·7	42·1	44·8	47·8	51·1	54·7	56·7	58·8	60·9	63·2
6·00	29·7	31·2	32·8	34·6	36·5	38·7	41·1	43·8	46·8	50·1	53·8	55·8	57·9	60·1	62·4
6·20	28·9	30·3	31·9	33·7	35·6	37·8	40·2	42·9	45·9	49·2	52·9	54·9	57·1	59·3	61·6
6·40	28·1	29·5	31·1	32·9	34·8	36·9	39·3	42·0	45·0	48·3	52·0	54·1	56·2	58·5	60·8
6·60	27·4	28·8	30·3	32·1	34·0	36·1	38·5	41·1	44·1	47·4	51·2	53·2	55·4	57·7	60·1
6·80	26·7	28·1	29·6	31·3	33·2	35·3	37·6	40·3	43·2	46·6	50·4	52·4	54·6	56·9	59·3
7·00	26·0	27·4	28·9	30·6	32·4	34·5	36·8	39·4	42·4	45·7	49·5	51·6	53·8	56·1	58·6
7·20	25·4	26·7	28·2	29·9	31·7	33·7	36·1	38·7	41·6	44·9	48·7	50·8	53·0	55·4	57·9
7·40	24·8	26·1	27·6	29·2	31·0	33·0	35·3	37·9	40·8	44·2	48·0	50·0	52·3	54·7	57·2
7·60	24·2	25·5	26·9	28·5	30·3	32·3	34·6	37·2	40·1	43·4	47·2	49·3	51·5	53·9	56·5
7·80	23·7	24·9	26·4	27·9	29·7	31·7	33·9	36·4	39·3	42·7	46·5	48·6	50·8	53·2	55·8

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION.

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	83½°	84°	84¼°	85°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
8·0	23·1	24·4	25·8	27·3	29·1	31·0	33·2	35·7	38·6	41·9	45·7	47·8	50·1	52·5	55·1
8·2	22·6	23·9	25·2	26·8	28·5	30·4	32·6	35·1	37·9	41·2	45·0	47·1	49·4	51·8	54·4
8·4	22·2	23·4	24·7	26·2	27·9	29·8	32·0	34·4	37·3	40·5	44·3	46·4	48·7	51·2	53·8
8·6	21·7	22·9	24·2	25·7	27·3	29·2	31·4	33·8	36·6	39·9	43·7	45·8	48·0	50·5	53·1
8·8	21·2	22·4	23·7	25·2	26·8	28·7	30·8	33·2	36·0	39·2	43·0	45·1	47·4	49·9	52·5
9·0	20·8	22·0	23·2	24·7	26·3	28·1	30·2	32·6	35·4	38·6	42·4	44·5	46·7	49·2	51·9
9·2	20·4	21·5	22·8	24·2	25·8	27·6	29·7	32·0	34·8	38·0	41·7	43·8	46·1	48·6	51·3
9·4	20·0	21·1	22·3	23·7	25·3	27·1	29·1	31·5	34·2	37·4	41·1	43·2	45·5	48·0	50·7
9·6	19·6	20·7	21·9	23·3	24·8	26·6	28·6	31·0	33·7	36·8	40·5	42·6	44·9	47·4	50·1
9·8	19·2	20·3	21·5	22·9	24·4	26·1	28·1	30·4	33·1	36·2	39·9	42·0	44·3	46·8	49·5
10·0	18·9	19·9	21·1	22·5	24·0	25·7	27·7	29·9	32·6	35·7	39·4	41·5	43·7	46·2	48·9
10·2	18·5	19·6	20·7	22·1	23·5	25·2	27·2	29·4	32·1	35·2	38·8	40·9	43·2	45·6	48·4
10·4	18·2	19·2	20·4	21·7	23·1	24·8	26·7	29·0	31·6	34·6	38·3	40·3	42·6	45·1	47·8
10·6	17·9	18·9	20·1	21·3	22·8	24·4	26·3	28·5	31·1	34·1	37·7	39·8	42·1	44·5	47·3
10·8	17·6	18·6	19·7	20·9	22·4	24·0	25·9	28·1	30·6	33·6	37·2	39·3	41·5	44·0	46·7
11·0	17·3	18·3	19·4	20·6	22·0	23·6	25·5	27·6	30·2	33·2	36·7	38·8	41·0	43·5	46·2
11·2	17·0	17·9	19·0	20·3	21·6	23·2	25·1	27·2	29·7	32·7	36·2	38·3	40·5	43·0	45·7
11·4	16·7	17·7	18·7	19·9	21·3	22·9	24·7	26·8	29·3	32·2	35·7	37·8	40·0	42·5	45·2
11·6	16·4	17·4	18·4	19·6	21·0	22·5	24·3	26·4	28·9	31·8	35·3	37·3	39·5	42·0	44·7
11·8	16·2	17·1	18·1	19·3	20·6	22·2	23·9	26·0	28·4	31·3	34·8	36·8	39·0	41·5	44·2
12·0	15·9	16·8	17·8	19·0	20·3	21·8	23·6	25·6	28·0	30·9	34·4	36·4	38·6	41·0	43·7
12·2	15·7	16·6	17·6	18·7	20·0	21·5	23·2	25·3	27·7	30·5	33·9	35·9	38·1	40·5	43·2
12·4	15·4	16·3	17·3	18·4	19·7	21·2	22·9	24·9	27·3	30·1	33·5	35·5	37·7	40·1	42·8
12·6	15·2	16·1	17·0	18·2	19·4	20·9	22·6	24·6	26·9	29·7	33·1	35·0	37·2	39·6	42·3
12·8	15·0	15·8	16·8	17·9	19·2	20·6	22·3	24·2	26·5	29·3	32·7	34·6	36·8	39·2	41·9
13·0	14·7	15·6	16·6	17·6	18·9	20·3	22·0	23·9	26·2	28·9	32·3	34·2	36·3	38·7	41·4
13·2	14·5	15·4	16·3	17·4	18·6	20·0	21·7	23·6	25·8	28·6	31·9	33·8	35·9	38·3	41·0
13·4	14·3	15·1	16·1	17·1	18·4	19·7	21·4	23·3	25·5	28·2	31·5	33·4	35·5	37·9	40·6
13·6	14·1	14·9	15·9	16·9	18·1	19·5	21·1	22·9	25·2	27·8	31·1	33·0	35·1	37·5	40·2
13·8	13·9	14·7	15·6	16·7	17·9	19·2	20·8	22·7	24·9	27·5	30·7	32·6	34·7	37·1	39·7
14·0	13·7	14·5	15·4	16·5	17·6	19·0	20·5	22·4	24·5	27·2	30·4	32·3	34·3	36·7	39·3
14·2	13·5	14·3	15·2	16·2	17·4	18·7	20·3	22·1	24·2	26·8	30·0	31·9	34·0	36·3	38·9
14·4	13·4	14·1	15·0	16·0	17·2	18·5	20·0	21·8	23·9	26·5	29·7	31·5	33·6	35·9	38·5
14·6	13·2	14·0	14·8	15·8	16·9	18·2	19·7	21·5	23·6	26·2	29·3	31·2	33·2	35·6	38·2
14·8	13·0	13·8	14·6	15·6	16·7	18·0	19·5	21·3	23·4	25·9	29·0	30·8	32·9	35·2	37·8
15·0	12·8	13·6	14·4	15·4	16·5	17·8	19·3	21·0	23·1	25·6	28·7	30·5	32·5	34·8	37·4
15·2	12·7	13·4	14·3	15·2	16·3	17·6	19·0	20·8	22·8	25·3	28·4	30·2	32·2	34·5	37·0
15·4	12·5	13·3	14·1	15·0	16·1	17·3	18·8	20·5	22·5	25·0	28·0	29·8	31·8	34·1	36·7
15·6	12·4	13·1	13·9	14·8	15·9	17·1	18·6	20·3	22·3	24·7	27·7	29·5	31·5	33·8	36·3
15·8	12·2	12·9	13·7	14·7	15·7	16·9	18·4	20·0	22·0	24·5	27·4	29·2	31·2	33·4	36·0
16·0	12·1	12·8	13·6	14·5	15·5	16·7	18·1	19·8	21·8	24·2	27·2	28·9	30·9	33·1	35·6
16·2	11·9	12·6	13·4	14·3	15·3	16·5	17·9	19·6	21·5	23·9	26·9	28·6	30·6	32·8	35·3
16·4	11·8	12·5	13·3	14·1	15·2	16·3	17·7	19·3	20·3	23·7	26·6	28·3	30·3	32·5	35·0
16·6	11·6	12·3	13·1	14·0	15·0	16·2	17·5	19·1	21·1	23·4	26·3	28·0	30·0	32·2	34·7
16·8	11·5	12·2	13·0	13·8	14·8	16·0	17·3	18·9	20·8	23·2	26·0	27·7	29·7	31·8	34·3
17·0	11·4	12·0	12·8	13·7	14·7	15·8	17·1	18·7	20·6	22·9	25·8	27·5	29·4	31·5	34·0
17·2	11·2	11·9	12·7	13·5	14·5	15·6	16·9	18·5	20·4	22·7	25·5	27·2	29·1	31·2	33·7
17·4	11·1	11·8	12·5	13·4	14·3	15·5	16·8	18·3	20·2	22·4	25·2	26·9	28·8	30·9	33·4
17·6	11·0	11·6	12·4	13·2	14·2	15·3	16·6	18·1	20·0	22·2	25·0	26·7	28·5	30·7	33·1
17·8	10·9	11·5	12·2	13·1	14·0	15·1	16·4	17·9	19·8	22·0	24·7	26·4	28·3	30·4	32·8
18·0	10·8	11·4	12·1	12·9	13·9	15·0	16·2	17·7	19·6	21·8	24·5	26·1	28·0	30·1	32·5
18·2	10·6	11·3	12·0	12·8	13·7	14·8	16·1	17·6	19·4	21·5	24·3	25·9	27·7	29·8	32·2
18·4	10·5	11·2	11·9	12·7	13·6	14·6	15·9	17·4	19·2	21·3	24·0	25·6	27·5	29·6	31·9
18·6	10·4	11·0	11·7	12·5	13·4	14·5	15·7	17·2	19·0	21·1	23·8	25·4	27·2	29·3	31·7
18·8	10·3	10·9	11·6	12·4	13·3	14·3	15·6	17·0	18·8	20·9	23·6	25·2	27·0	29·0	31·4

Table C.

AZIMUTHS CORRESPONDING TO THE A AND B CORRECTION

Azimuth is named N or S according to the name of the A and B correction.

A and B Correction.	LATITUDES.														
	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	83½°	84°	84½°	85°
	AZIMUTHS.														
′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
19·0	10·2	10·8	11·5	12·3	13·2	14·2	15·4	16·9	18·6	20·7	23·4	24·9	26·7	28·8	31·1
19·2	10·1	10·7	11·4	12·1	13·0	14·1	15·3	16·7	18·4	20·5	23·1	24·7	26·5	28·5	30·9
19·4	10·0	10·6	11·3	12·0	12·9	13·9	15·1	16·5	18·2	20·3	22·9	24·5	26·2	28·3	30·6
19·6	9·9	10·5	11·2	11·9	12·8	13·8	15·0	16·4	18·1	20·1	22·7	24·3	26·0	28·0	30·3
19·8	9·8	10·4	11·0	11·8	12·7	13·7	14·8	16·2	17·9	19·9	22·5	24·0	25·8	27·8	30·1
20·0	9·7	10·3	10·9	11·7	12·5	13·5	14·7	16·1	17·7	19·8	22·3	23·8	25·6	27·5	29·8
21·0	9·3	9·8	10·4	11·1	12·0	12·9	14·0	15·3	16·9	18·9	21·3	22·8	24·5	26·4	28·7
22·0	8·8	9·4	10·0	10·6	11·4	12·3	13·4	14·7	16·2	18·1	20·5	21·9	23·5	25·4	27·5
23·0	8·5	9·0	9·5	10·2	10·9	11·8	12·8	14·1	15·5	17·3	19·6	21·0	22·6	24·4	26·5
24·0	8·1	8·6	9·1	9·8	10·5	11·3	12·3	13·5	14·9	16·7	18·9	20·2	21·7	23·5	25·6
25·0	7·8	8·3	8·8	9·4	10·1	10·9	11·8	13·0	14·3	16·0	18·2	19·5	20·9	22·6	24·7
26·0	7·5	7·9	8·5	9·0	9·7	10·5	11·4	12·5	13·8	15·4	17·5	18·8	20·2	21·9	23·8
27·0	7·2	7·7	8·1	8·7	9·3	10·1	11·0	12·0	13·3	14·9	16·9	18·1	19·5	21·1	23·0
28·0	7·0	7·4	7·9	8·4	9·0	9·7	10·6	11·6	12·9	14·4	16·3	17·5	18·9	20·4	22·3
29·0	6·7	7·1	7·6	8·1	8·7	9·4	10·2	11·2	12·4	13·9	15·8	16·9	18·3	19·8	21·6
30·0	6·5	6·9	7·3	7·8	8·4	9·1	9·9	10·9	12·0	13·5	15·3	16·4	17·7	19·2	20·9
31·0	6·3	6·7	7·1	7·6	8·2	8·8	9·6	10·5	11·7	13·0	14·8	15·9	17·2	18·6	20·3
32·0	6·1	6·5	6·9	7·4	7·9	8·5	9·3	10·2	11·3	12·7	14·4	15·4	16·6	18·1	19·7
33·0	5·9	6·3	6·7	7·1	7·7	8·3	9·0	9·9	11·0	12·3	14·0	15·0	16·2	17·5	19·2
34·0	5·7	6·1	6·5	6·9	7·4	8·1	8·8	9·6	10·6	11·9	13·6	14·6	15·7	17·1	18·6
35·0	5·6	5·9	6·3	6·7	7·2	7·8	8·5	9·3	10·4	11·6	13·2	14·2	15·3	16·6	18·2
36·0	5·4	5·8	6·1	6·6	7·0	7·6	8·3	9·1	10·1	11·3	12·8	13·8	14·9	16·2	17·7
37·0	5·3	5·6	6·0	6·4	6·9	7·4	8·1	8·8	9·8	11·0	12·5	13·4	14·5	15·7	17·2
38·0	5·1	5·5	5·8	6·2	6·7	7·2	7·9	8·6	9·5	10·7	12·2	13·1	14·1	15·4	16·8
40·0	4·9	5·2	5·5	5·9	6·3	6·9	7·5	8·2	9·1	10·2	11·6	12·5	13·5	14·6	16·0
42·0	4·7	4·9	5·3	5·6	6·0	6·5	7·1	7·8	8·7	9·7	11·1	11·9	12·8	14·0	15·3
44·0	4·4	4·7	5·0	5·4	5·8	6·2	6·8	7·5	8·3	9·3	10·6	11·4	12·3	13·3	14·6
46·0	4·3	4·5	4·8	5·1	5·5	6·0	6·5	7·1	7·9	8·9	10·1	10·9	11·7	12·8	14·0
48·0	4·1	4·3	4·6	4·9	5·3	5·7	6·2	6·8	7·6	8·5	9·7	10·4	11·3	12·3	13·4
50·0	3·9	4·2	4·4	4·7	5·1	5·5	6·0	6·6	7·3	8·2	9·3	10·0	10·8	11·8	12·9
52·0	3·8	4·0	4·2	4·5	4·9	5·3	5·8	6·3	7·0	7·9	9·0	9·6	10·4	11·3	12·4
54·0	3·6	3·8	4·1	4·4	4·7	5·1	5·5	6·1	6·8	7·6	8·6	9·3	10·0	10·9	12·0
56·0	3·5	3·7	3·9	4·2	4·5	4·9	5·3	5·9	6·5	7·3	8·3	9·0	9·7	10·6	11·6
58·0	3·4	3·6	3·8	4·1	4·4	4·7	5·2	5·7	6·3	7·1	8·1	8·7	9·4	10·2	11·2
60·0	3·3	3·5	3·7	3·9	4·2	4·6	5·0	5·5	6·1	6·8	7·8	8·4	9·1	9·9	10·8
62·0	3·2	3·3	3·6	3·8	4·1	4·4	4·8	5·3	5·9	6·6	7·5	8·1	8·8	9·6	10·5
64·0	3·1	3·2	3·5	3·7	4·0	4·3	4·7	5·1	5·7	6·4	7·3	7·9	8·5	9·3	10·2
66·0	3·0	3·1	3·4	3·6	3·9	4·2	4·5	5·0	5·5	6·2	7·1	7·6	8·2	9·0	9·9
68·0	2·9	3·1	3·3	3·5	3·7	4·0	4·4	4·8	5·4	6·0	6·9	7·4	8·0	8·7	9·6
70·0	2·8	3·0	3·2	3·4	3·6	3·9	4·3	4·7	5·2	5·9	6·7	7·2	7·8	8·5	9·3
80·0	2·4	2·6	2·8	3·0	3·2	3·4	3·7	4·1	4·6	5·1	5·9	6·3	6·8	7·4	8·2
90·0	2·2	2·3	2·5	2·6	2·8	3·1	3·3	3·7	4·1	4·6	5·2	5·6	6·1	6·6	7·3
100·0	2·0	2·1	2·2	2·4	2·5	2·8	3·0	3·3	3·7	4·1	4·7	5·0	5·5	6·0	6·5
120·0	1·6	1·7	1·8	2·0	2·1	2·3	2·5	2·7	3·0	3·4	3·9	4·2	4·6	5·0	5·5
140·0	1·4	1·5	1·6	1·7	1·8	2·0	2·1	2·4	2·6	2·9	3·4	3·6	3·9	4·3	4·7
160·0	1·2	1·3	1·4	1·5	1·6	1·7	1·9	2·1	2·3	2·6	2·9	3·2	3·4	3·7	4·1
180·0	1·1	1·2	1·2	1·3	1·4	1·5	1·7	1·8	2·0	2·3	2·6	2·8	3·0	3·3	3·6
200·0	1·0	1·0	1·1	1·2	1·3	1·4	1·5	1·6	1·8	2·1	2·3	2·5	2·7	3·0	3·3
300·0	0·7	0·7	0·7	0·8	0·8	0·9	1·0	1·1	1·2	1·4	1·6	1·7	1·8	2·0	2·2
400·0	0·5	0·5	0·6	0·6	0·6	0·7	0·8	0·8	0·9	1·0	1·2	1·3	1·4	1·5	1·6
500·0	0·4	0·4	0·4	0·5	0·5	0·6	0·6	0·7	0·7	0·8	0·9	1·0	1·1	1·2	1·3
600·0	0·3	0·3	0·4	0·4	0·4	0·5	0·5	0·5	0·6	0·7	0·8	0·8	0·9	1·0	1·1
700·0	0·3	0·3	0·3	0·3	0·4	0·4	0·4	0·5	0·5	0·6	0·7	0·7	0·8	0·9	0·9
800·0	0·2	0·3	0·3	0·3	0·3	0·3	0·4	0·4	0·5	0·5	0·6	0·6	0·7	0·7	0·8
1000·0	0·2	0·2	0·2	0·2	0·3	0·3	0·3	0·3	0·4	0·4	0·5	0·5	0·5	0·6	0·7

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.															
	·10	·11	·12	·13	·14	·15	·16	·17	·18	·19	·20	·21	·22	·23	·24	·25
°																
2	·100	·110	·120	·130	·140	·150	·160	·170	·180	·190	·200	·210	·220	·230	·240	·250
4	·100	·110	·120	·130	·140	·150	·160	·170	·180	·190	·200	·209	·219	·229	·239	·249
6	·099	·109	·119	·129	·139	·149	·159	·169	·179	·189	·199	·209	·219	·229	·239	·249
8	·099	·109	·119	·129	·139	·148	·158	·168	·178	·188	·198	·208	·218	·228	·238	·248
10	·098	·108	·118	·128	·138	·148	·158	·167	·177	·187	·197	·207	·217	·227	·236	·246
11	·098	·108	·118	·128	·137	·147	·157	·167	·177	·187	·196	·206	·216	·226	·236	·245
12	·098	·108	·117	·127	·137	·147	·157	·166	·176	·186	·196	·205	·215	·225	·235	·245
13	·097	·107	·117	·127	·136	·146	·156	·166	·175	·185	·195	·205	·214	·224	·234	·244
14	·097	·107	·116	·126	·136	·146	·155	·165	·175	·184	·194	·204	·213	·223	·233	·243
15	·097	·106	·116	·126	·135	·145	·155	·164	·174	·184	·193	·203	·213	·222	·232	·241
16	·096	·106	·115	·125	·135	·144	·154	·163	·173	·183	·192	·202	·211	·221	·231	·240
17	·096	·105	·115	·124	·134	·143	·153	·163	·172	·182	·191	·201	·210	·220	·230	·239
18	·095	·105	·114	·124	·133	·143	·152	·162	·171	·181	·190	·200	·209	·219	·228	·238
19	·095	·104	·113	·123	·132	·142	·151	·161	·170	·180	·189	·199	·208	·217	·227	·236
20	·094	·103	·113	·122	·132	·141	·150	·160	·169	·179	·188	·197	·207	·216	·226	·235
21	·093	·103	·112	·121	·131	·140	·149	·159	·168	·177	·187	·196	·205	·215	·224	·233
22	·093	·102	·111	·121	·130	·139	·148	·158	·167	·176	·185	·195	·204	·213	·223	·232
23	·092	·101	·110	·120	·129	·138	·147	·156	·166	·175	·184	·193	·203	·212	·221	·230
24	·091	·100	·110	·119	·128	·137	·146	·155	·164	·174	·183	·192	·201	·210	·219	·228
25	·091	·100	·109	·118	·127	·136	·145	·154	·163	·172	·181	·190	·199	·208	·218	·227
26	·090	·099	·108	·117	·126	·135	·144	·153	·162	·171	·180	·189	·198	·207	·216	·225
27	·089	·098	·107	·116	·125	·134	·143	·151	·160	·169	·178	·187	·196	·205	·214	·223
28	·088	·097	·106	·115	·124	·132	·141	·150	·159	·168	·177	·185	·194	·203	·212	·221
29	·087	·096	·105	·114	·122	·131	·140	·149	·157	·166	·175	·184	·192	·201	·210	·219
30	·087	·095	·104	·113	·121	·130	·139	·147	·156	·165	·173	·182	·191	·199	·208	·217
31	·086	·094	·103	·111	·120	·129	·137	·146	·154	·163	·171	·180	·189	·197	·206	·214
32	·085	·093	·102	·110	·119	·127	·136	·144	·153	·161	·170	·178	·187	·195	·204	·212
33	·084	·092	·101	·109	·117	·126	·134	·143	·151	·159	·168	·176	·185	·193	·201	·210
34	·083	·091	·099	·108	·116	·124	·133	·141	·149	·158	·166	·174	·182	·191	·199	·207
35	·082	·090	·098	·106	·115	·123	·131	·139	·147	·156	·164	·172	·180	·188	·197	·205
36	·081	·089	·097	·105	·113	·121	·129	·138	·146	·154	·162	·170	·178	·186	·194	·202
37	·080	·088	·096	·104	·112	·120	·128	·136	·144	·152	·160	·168	·176	·184	·192	·200
38	·079	·087	·095	·102	·110	·118	·126	·134	·142	·150	·158	·165	·173	·181	·189	·197
39	·078	·085	·093	·101	·109	·117	·124	·132	·140	·148	·155	·163	·171	·179	·187	·194
40	·077	·084	·092	·100	·107	·115	·123	·130	·138	·146	·153	·161	·169	·176	·184	·192
41	·075	·083	·091	·098	·106	·113	·121	·128	·136	·143	·151	·158	·166	·174	·181	·189
42	·074	·082	·089	·097	·104	·111	·119	·126	·134	·141	·149	·156	·163	·171	·178	·186
43	·073	·080	·088	·095	·102	·110	·117	·124	·132	·139	·146	·154	·161	·168	·176	·183
44	·072	·079	·086	·094	·101	·108	·115	·122	·129	·137	·144	·151	·158	·165	·173	·180
45	·071	·078	·085	·092	·099	·106	·113	·120	·127	·134	·141	·148	·156	·163	·170	·177
46	·069	·076	·083	·090	·097	·104	·111	·118	·125	·132	·139	·146	·153	·160	·167	·174
47	·068	·075	·082	·089	·095	·102	·109	·116	·123	·130	·136	·143	·150	·157	·164	·170
48	·067	·074	·080	·087	·094	·100	·107	·114	·120	·127	·134	·141	·147	·154	·161	·167
49	·066	·072	·079	·085	·092	·098	·105	·112	·118	·125	·131	·138	·144	·151	·157	·164
50	·064	·071	·077	·084	·090	·096	·103	·109	·116	·122	·129	·135	·141	·148	·154	·161
51	·063	·069	·076	·082	·088	·094	·101	·107	·113	·120	·126	·132	·138	·145	·151	·157
52	·062	·068	·074	·080	·086	·092	·099	·105	·111	·117	·123	·129	·135	·142	·148	·154
53	·060	·066	·072	·078	·084	·090	·096	·102	·108	·114	·120	·126	·132	·138	·144	·150
54	·059	·065	·071	·076	·082	·088	·094	·100	·106	·112	·118	·123	·129	·135	·141	·147
55	·057	·063	·069	·075	·080	·086	·092	·098	·103	·109	·115	·120	·126	·132	·138	·143
56	·056	·062	·067	·073	·078	·084	·089	·095	·101	·106	·112	·117	·123	·129	·134	·140
57	·054	·060	·065	·071	·076	·082	·087	·093	·098	·103	·109	·114	·120	·125	·130	·136
58	·053	·058	·064	·069	·074	·079	·085	·090	·095	·101	·106	·111	·117	·122	·127	·132
59	·052	·057	·062	·067	·072	·077	·082	·088	·093	·098	·103	·108	·113	·118	·124	·129
60	·050	·055	·060	·065	·070	·075	·080	·085	·090	·095	·100	·105	·110	·115	·120	·125
61	·048	·053	·058	·063	·068	·073	·078	·082	·087	·092	·097	·102	·107	·112	·116	·121
62	·047	·052	·056	·061	·066	·070	·075	·080	·085	·089	·094	·099	·103	·108	·113	·117
63	·045	·050	·054	·059	·064	·068	·073	·077	·082	·086	·091	·095	·100	·104	·109	·113
64	·044	·048	·053	·057	·061	·066	·070	·075	·079	·083	·088	·092	·096	·101	·105	·110
65	·042	·046	·051	·055	·059	·063	·068	·072	·076	·080	·085	·089	·093	·097	·101	·106

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.														
	·26	·27	·28	·29	·30	·31	·32	·33	·34	·35	·36	·37	·38	·39	·40
°															
2	·260	·270	·280	·290	·300	·310	·320	·330	·340	·350	·360	·370	·380	·390	·400
4	·259	·269	·279	·289	·299	·309	·319	·329	·339	·349	·359	·369	·379	·389	·399
6	·259	·269	·278	·288	·298	·308	·318	·328	·338	·348	·358	·368	·378	·388	·398
8	·257	·267	·277	·287	·297	·307	·317	·327	·337	·347	·356	·366	·376	·386	·396
10	·256	·266	·276	·286	·295	·305	·315	·325	·335	·345	·355	·364	·374	·384	·394
11	·255	·265	·275	·285	·294	·304	·314	·324	·334	·344	·353	·363	·373	·383	·393
12	·254	·264	·274	·284	·293	·303	·313	·323	·333	·342	·352	·362	·372	·381	·391
13	·253	·263	·273	·283	·292	·302	·312	·322	·331	·341	·351	·361	·370	·380	·390
14	·252	·262	·272	·281	·291	·301	·310	·320	·330	·340	·349	·359	·369	·378	·388
15	·251	·261	·270	·280	·290	·299	·309	·319	·328	·338	·348	·357	·367	·377	·386
16	·250	·260	·269	·279	·288	·298	·308	·317	·327	·336	·346	·356	·365	·375	·385
17	·249	·258	·268	·277	·287	·296	·306	·316	·325	·335	·344	·354	·363	·373	·383
18	·247	·257	·266	·276	·285	·295	·304	·314	·323	·333	·342	·352	·361	·371	·380
19	·246	·255	·265	·274	·284	·293	·303	·312	·321	·331	·340	·350	·359	·369	·378
20	·244	·254	·263	·273	·282	·291	·301	·310	·319	·329	·338	·348	·357	·366	·376
21	·243	·252	·261	·271	·280	·289	·299	·308	·317	·327	·336	·345	·355	·364	·373
22	·241	·250	·260	·269	·278	·287	·297	·306	·315	·325	·334	·343	·352	·362	·371
23	·239	·249	·258	·267	·276	·285	·295	·304	·313	·322	·331	·341	·350	·359	·368
24	·238	·247	·256	·265	·274	·283	·292	·301	·311	·320	·329	·338	·347	·356	·365
25	·236	·245	·254	·263	·272	·281	·290	·299	·308	·317	·326	·335	·344	·353	·363
26	·234	·243	·252	·261	·270	·279	·288	·297	·306	·315	·324	·333	·342	·351	·360
27	·232	·241	·249	·258	·267	·276	·285	·294	·303	·312	·321	·330	·339	·347	·356
28	·230	·238	·247	·256	·265	·274	·283	·291	·300	·309	·318	·327	·336	·344	·353
29	·227	·236	·245	·254	·262	·271	·280	·289	·297	·306	·315	·324	·332	·341	·350
30	·225	·234	·242	·251	·260	·268	·277	·286	·294	·303	·312	·320	·329	·338	·346
31	·223	·231	·240	·249	·257	·266	·274	·283	·291	·300	·309	·317	·326	·334	·343
32	·220	·229	·237	·246	·254	·263	·271	·280	·288	·297	·305	·314	·322	·331	·339
33	·218	·226	·235	·243	·252	·260	·268	·277	·285	·294	·302	·310	·319	·327	·335
34	·216	·224	·232	·240	·249	·257	·265	·274	·282	·290	·298	·307	·315	·323	·332
35	·213	·221	·229	·238	·246	·254	·262	·270	·279	·287	·295	·303	·311	·319	·328
36	·210	·218	·227	·235	·243	·251	·259	·267	·275	·283	·291	·299	·307	·316	·324
37	·208	·216	·224	·232	·240	·248	·256	·264	·272	·280	·288	·295	·303	·311	·319
38	·205	·213	·221	·229	·236	·244	·252	·260	·268	·276	·284	·292	·299	·307	·315
39	·202	·210	·218	·225	·233	·241	·249	·256	·264	·272	·280	·288	·295	·303	·311
40	·199	·207	·214	·222	·230	·237	·245	·253	·260	·268	·276	·283	·291	·299	·306
41	·196	·204	·211	·219	·226	·234	·242	·249	·257	·264	·272	·279	·287	·294	·302
42	·193	·201	·208	·216	·223	·230	·238	·245	·253	·260	·268	·275	·282	·290	·297
43	·190	·197	·205	·212	·219	·227	·234	·241	·249	·256	·263	·271	·278	·285	·293
44	·187	·194	·201	·209	·216	·223	·230	·237	·245	·252	·259	·266	·273	·281	·288
45	·184	·191	·198	·205	·212	·219	·226	·233	·240	·247	·255	·262	·269	·276	·283
46	·181	·188	·195	·201	·208	·215	·222	·229	·236	·243	·250	·257	·264	·271	·278
47	·177	·184	·191	·198	·205	·211	·218	·225	·232	·239	·246	·252	·259	·266	·273
48	·174	·181	·187	·194	·201	·207	·214	·221	·228	·234	·241	·248	·254	·261	·268
49	·171	·177	·184	·190	·197	·203	·210	·216	·223	·230	·236	·243	·249	·256	·262
50	·167	·174	·180	·186	·193	·199	·206	·212	·219	·225	·231	·238	·244	·251	·257
51	·164	·170	·176	·183	·189	·195	·201	·208	·214	·220	·227	·233	·239	·245	·252
52	·160	·166	·172	·179	·185	·191	·197	·203	·209	·215	·222	·228	·234	·240	·246
53	·156	·162	·169	·175	·181	·187	·193	·199	·205	·211	·217	·223	·229	·235	·241
54	·153	·159	·165	·170	·176	·182	·188	·194	·200	·206	·212	·217	·223	·229	·235
55	·149	·155	·161	·166	·172	·178	·184	·189	·195	·201	·206	·212	·218	·224	·229
56	·145	·151	·157	·162	·168	·173	·179	·185	·190	·196	·201	·207	·212	·218	·224
57	·142	·147	·152	·158	·163	·169	·174	·180	·185	·191	·196	·202	·207	·212	·218
58	·138	·143	·148	·154	·159	·164	·170	·175	·180	·185	·191	·196	·201	·207	·212
59	·134	·139	·144	·149	·155	·160	·165	·170	·175	·180	·185	·191	·196	·201	·206
60	·130	·135	·140	·145	·150	·155	·160	·165	·170	·175	·180	·185	·190	·195	·200
61	·126	·131	·136	·141	·145	·150	·155	·160	·165	·170	·175	·179	·184	·189	·194
62	·122	·127	·131	·136	·141	·146	·150	·155	·160	·164	·169	·174	·178	·183	·188
63	·118	·123	·127	·132	·136	·141	·145	·150	·154	·159	·163	·168	·173	·177	·182
64	·114	·118	·123	·127	·132	·136	·140	·145	·149	·153	·158	·162	·167	·171	·751
65	·110	·114	·118	·123	·127	·131	·135	·139	·144	·148	·152	·156	·161	·165	·169

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.														
	·41	·42	·43	·44	·45	·46	·47	·48	·49	·50	·51	·52	·53	·54	·55
°															
2	·410	·420	·430	·440	·450	·460	·470	·480	·490	·500	·510	·520	·530	·540	·550
4	·409	·419	·429	·439	·449	·459	·469	·479	·489	·499	·509	·519	·529	·539	·549
6	·408	·418	·428	·438	·448	·457	·467	·477	·487	·497	·507	·517	·527	·537	·547
8	·406	·416	·426	·436	·446	·456	·465	·475	·485	·495	·505	·515	·525	·535	·545
10	·404	·414	·423	·433	·443	·453	·463	·473	·483	·492	·502	·512	·522	·532	·542
11	·402	·412	·422	·432	·442	·452	·461	·471	·481	·491	·501	·510	·520	·530	·540
12	·401	·411	·421	·430	·440	·450	·460	·470	·479	·489	·499	·509	·518	·528	·538
13	·399	·409	·419	·429	·438	·448	·458	·468	·477	·487	·497	·507	·516	·526	·536
14	·398	·408	·417	·427	·437	·446	·456	·466	·475	·485	·495	·505	·514	·524	·534
15	·396	·406	·415	·425	·435	·444	·454	·464	·473	·483	·493	·502	·512	·522	·531
16	·394	·404	·413	·423	·433	·442	·452	·461	·471	·481	·490	·500	·509	·519	·529
17	·392	·402	·411	·421	·430	·440	·449	·459	·469	·478	·488	·497	·507	·516	·526
18	·390	·399	·409	·418	·428	·437	·447	·457	·466	·476	·485	·495	·504	·514	·523
19	·388	·397	·407	·416	·425	·435	·444	·454	·463	·473	·482	·492	·501	·511	·520
20	·385	·395	·404	·413	·423	·432	·442	·451	·460	·470	·479	·489	·498	·507	·517
21	·383	·392	·401	·411	·420	·429	·439	·448	·457	·467	·476	·485	·495	·504	·513
22	·380	·389	·399	·408	·417	·427	·436	·445	·454	·464	·473	·482	·491	·501	·510
23	·377	·387	·396	·405	·414	·423	·433	·442	·451	·460	·469	·479	·488	·497	·506
24	·375	·384	·393	·402	·411	·420	·429	·439	·448	·457	·466	·475	·484	·493	·502
25	·372	·381	·390	·399	·408	·417	·426	·435	·444	·453	·462	·471	·480	·489	·498
26	·369	·377	·386	·395	·404	·413	·422	·431	·440	·449	·458	·467	·476	·485	·494
27	·365	·374	·383	·392	·401	·410	·419	·428	·437	·446	·454	·463	·472	·481	·490
28	·362	·371	·380	·388	·397	·406	·415	·424	·433	·441	·450	·459	·468	·477	·486
29	·359	·367	·376	·385	·394	·402	·411	·420	·429	·437	·446	·455	·464	·472	·481
30	·355	·364	·372	·381	·390	·398	·407	·416	·424	·433	·442	·450	·459	·468	·476
31	·351	·360	·369	·377	·386	·394	·403	·411	·420	·429	·437	·446	·454	·463	·471
32	·348	·356	·365	·373	·382	·390	·399	·407	·416	·424	·433	·441	·449	·458	·466
33	·344	·352	·361	·369	·377	·386	·394	·403	·411	·419	·428	·436	·444	·453	·461
34	·340	·348	·356	·365	·373	·381	·390	·398	·406	·415	·423	·431	·439	·448	·456
35	·336	·344	·352	·360	·369	·377	·385	·393	·401	·410	·418	·426	·434	·442	·451
36	·332	·340	·348	·356	·364	·372	·380	·388	·396	·405	·413	·421	·429	·437	·445
37	·327	·335	·343	·351	·359	·367	·375	·383	·391	·399	·407	·415	·423	·431	·439
38	·323	·331	·339	·347	·355	·362	·370	·378	·386	·394	·402	·410	·418	·426	·433
39	·319	·326	·334	·342	·350	·357	·365	·373	·381	·389	·396	·404	·412	·420	·427
40	·314	·322	·329	·337	·345	·352	·360	·368	·375	·383	·391	·398	·406	·414	·421
41	·309	·317	·325	·332	·340	·347	·355	·362	·370	·377	·385	·392	·400	·408	·415
42	·305	·312	·320	·327	·334	·342	·349	·357	·364	·372	·379	·386	·394	·401	·409
43	·300	·307	·314	·322	·329	·336	·344	·351	·358	·366	·373	·380	·388	·395	·402
44	·295	·302	·309	·317	·324	·331	·338	·345	·352	·360	·367	·374	·381	·388	·396
45	·290	·297	·304	·311	·318	·325	·332	·339	·346	·354	·361	·368	·375	·382	·389
46	·285	·292	·299	·306	·313	·320	·326	·333	·340	·347	·354	·361	·368	·375	·382
47	·280	·286	·293	·300	·307	·314	·321	·327	·334	·341	·348	·355	·361	·368	·375
48	·274	·281	·288	·294	·301	·308	·314	·321	·328	·335	·341	·348	·355	·361	·368
49	·269	·276	·282	·289	·295	·302	·308	·315	·321	·328	·335	·341	·348	·354	·361
50	·264	·270	·276	·283	·289	·296	·302	·309	·315	·321	·328	·334	·341	·347	·354
51	·258	·264	·271	·277	·283	·289	·296	·302	·308	·315	·321	·327	·334	·340	·346
52	·252	·259	·265	·271	·277	·283	·289	·296	·302	·308	·314	·320	·326	·332	·339
53	·247	·253	·259	·265	·271	·277	·283	·289	·295	·301	·307	·313	·319	·325	·331
54	·241	·247	·253	·259	·265	·270	·276	·282	·288	·294	·300	·306	·312	·317	·323
55	·235	·241	·247	·252	·258	·264	·270	·275	·281	·287	·293	·298	·304	·310	·315
56	·229	·235	·240	·246	·252	·257	·263	·268	·274	·280	·285	·291	·296	·302	·308
57	·223	·229	·234	·240	·245	·251	·256	·261	·267	·272	·278	·283	·289	·294	·300
58	·217	·223	·228	·233	·238	·244	·249	·254	·260	·265	·270	·276	·281	·286	·291
59	·211	·216	·221	·227	·232	·237	·242	·247	·252	·258	·263	·268	·273	·278	·283
60	·205	·210	·215	·220	·225	·230	·235	·240	·245	·250	·255	·260	·265	·270	·275
61	·199	·204	·208	·213	·218	·223	·228	·233	·238	·242	·247	·252	·257	·262	·267
62	·192	·197	·202	·207	·211	·216	·221	·225	·230	·235	·239	·244	·249	·254	·258
63	·186	·191	·195	·200	·204	·209	·213	·218	·222	·227	·232	·236	·241	·245	·250
64	·180	·184	·188	·193	·197	·202	·206	·210	·215	·219	·224	·228	·232	·237	·241
65	·173	·177	·182	·186	·190	·194	·199	·203	·207	·211	·216	·220	·224	·228	·232

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.														
	·56	·57	·58	·59	·60	·61	·62	·63	·64	·65	·66	·67	·68	·69	·70
°															
2	·560	·570	·580	·590	·600	·610	·620	·630	·640	·650	·660	·670	·680	·690	·700
4	·559	·569	·579	·589	·599	·609	·618	·628	·638	·648	·658	·668	·678	·688	·698
6	·557	·567	·577	·587	·597	·607	·617	·627	·636	·646	·656	·666	·676	·686	·696
8	·555	·564	·574	·584	·594	·604	·614	·624	·634	·644	·654	·663	·673	·683	·693
10	·551	·561	·571	·581	·591	·601	·611	·620	·630	·640	·650	·660	·670	·680	·689
11	·550	·560	·569	·579	·589	·599	·609	·618	·628	·638	·648	·658	·668	·677	·687
12	·548	·558	·567	·577	·587	·597	·606	·616	·626	·636	·646	·655	·665	·675	·685
13	·546	·555	·565	·575	·585	·594	·604	·614	·624	·633	·643	·653	·663	·672	·682
14	·543	·553	·563	·572	·582	·592	·602	·611	·621	·631	·640	·650	·660	·670	·679
15	·541	·551	·560	·570	·580	·589	·599	·609	·618	·628	·638	·647	·657	·666	·676
16	·538	·548	·558	·567	·577	·586	·596	·606	·615	·625	·634	·644	·654	·663	·673
17	·536	·545	·555	·564	·574	·583	·593	·602	·612	·622	·631	·641	·650	·660	·669
18	·533	·542	·552	·561	·571	·580	·590	·599	·609	·618	·628	·637	·647	·656	·666
19	·529	·539	·548	·558	·567	·577	·586	·596	·605	·615	·624	·633	·643	·652	·662
20	·526	·536	·545	·554	·564	·573	·583	·592	·601	·611	·620	·630	·639	·648	·658
21	·523	·532	·541	·551	·560	·569	·579	·588	·597	·607	·616	·625	·635	·644	·654
22	·519	·528	·538	·547	·556	·566	·575	·584	·593	·603	·612	·621	·630	·640	·649
23	·515	·525	·534	·543	·552	·562	·571	·580	·589	·598	·608	·617	·626	·635	·644
24	·512	·521	·530	·539	·548	·557	·566	·576	·585	·594	·603	·612	·621	·630	·639
25	·508	·517	·526	·535	·544	·553	·562	·571	·580	·589	·598	·607	·616	·625	·634
26	·503	·512	·521	·530	·539	·548	·557	·566	·575	·584	·593	·602	·611	·620	·629
27	·499	·508	·517	·526	·535	·544	·552	·561	·570	·579	·588	·597	·606	·615	·624
28	·494	·503	·512	·521	·530	·539	·547	·556	·565	·574	·583	·592	·600	·609	·618
29	·490	·499	·507	·516	·525	·534	·542	·551	·560	·569	·577	·586	·595	·603	·612
30	·485	·494	·502	·511	·520	·528	·537	·546	·554	·563	·572	·580	·589	·598	·606
31	·480	·489	·497	·506	·514	·523	·531	·540	·549	·557	·566	·574	·583	·591	·600
32	·475	·483	·492	·500	·509	·517	·526	·534	·543	·551	·560	·568	·577	·585	·594
33	·470	·478	·486	·495	·503	·512	·520	·528	·537	·545	·554	·562	·570	·579	·587
34	·464	·473	·481	·489	·497	·506	·514	·522	·531	·539	·547	·555	·564	·572	·580
35	·459	·467	·475	·483	·491	·500	·508	·516	·524	·532	·541	·549	·557	·565	·573
36	·453	·461	·469	·477	·485	·494	·502	·510	·518	·526	·534	·542	·550	·558	·566
37	·447	·455	·463	·471	·479	·487	·495	·503	·511	·519	·527	·535	·543	·551	·559
38	·441	·449	·457	·465	·473	·481	·489	·496	·504	·512	·520	·528	·536	·544	·552
39	·435	·443	·451	·459	·466	·474	·482	·490	·497	·505	·513	·521	·528	·536	·544
40	·429	·437	·444	·452	·460	·467	·475	·483	·490	·498	·506	·513	·521	·529	·536
41	·423	·430	·438	·445	·453	·460	·468	·475	·483	·491	·498	·506	·513	·521	·528
42	·416	·424	·431	·438	·446	·453	·461	·468	·476	·483	·490	·498	·505	·513	·520
43	·410	·417	·424	·431	·439	·446	·453	·461	·468	·475	·483	·490	·497	·505	·512
44	·403	·410	·417	·424	·432	·439	·446	·453	·460	·468	·475	·482	·489	·496	·504
45	·396	·403	·410	·417	·424	·431	·438	·445	·453	·460	·467	·474	·481	·488	·495
46	·389	·396	·403	·410	·417	·424	·431	·438	·445	·452	·458	·465	·472	·479	·486
47	·382	·389	·396	·402	·409	·416	·423	·430	·436	·443	·450	·457	·464	·471	·477
48	·375	·381	·388	·395	·401	·408	·415	·422	·428	·435	·442	·448	·455	·462	·468
49	·367	·374	·381	·387	·394	·400	·407	·413	·420	·426	·433	·440	·446	·453	·459
50	·360	·366	·373	·379	·386	·392	·399	·405	·411	·418	·424	·431	·437	·444	·450
51	·352	·359	·365	·371	·378	·384	·390	·396	·403	·409	·415	·422	·428	·434	·441
52	·345	·351	·357	·363	·369	·376	·382	·388	·394	·400	·406	·412	·419	·425	·431
53	·337	·343	·349	·355	·361	·367	·373	·379	·385	·391	·397	·403	·409	·415	·421
54	·329	·335	·341	·347	·353	·359	·364	·370	·376	·382	·388	·394	·400	·406	·411
55	·321	·327	·333	·338	·344	·350	·356	·361	·367	·373	·379	·384	·390	·396	·402
56	·313	·319	·324	·330	·336	·341	·347	·352	·358	·363	·369	·375	·380	·386	·391
57	·305	·310	·316	·321	·327	·332	·338	·343	·349	·354	·359	·365	·370	·376	·381
58	·297	·302	·307	·313	·318	·323	·329	·334	·339	·344	·350	·355	·360	·366	·371
59	·288	·294	·299	·304	·309	·314	·319	·324	·330	·335	·340	·345	·350	·355	·361
60	·280	·285	·290	·295	·300	·305	·310	·315	·320	·325	·330	·335	·340	·345	·350
61	·271	·276	·281	·286	·291	·296	·301	·305	·310	·315	·320	·325	·330	·335	·339
62	·263	·268	·272	·277	·282	·286	·291	·296	·300	·305	·310	·315	·319	·324	·329
63	·254	·259	·263	·268	·272	·277	·281	·286	·291	·295	·300	·304	·309	·313	·318
64	·245	·250	·254	·259	·263	·267	·272	·276	·281	·285	·289	·294	·298	·302	·307
65	·237	·241	·245	·249	·254	·258	·262	·266	·270	·275	·279	·283	·287	·292	·296

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.														
	·71	·72	·73	·74	·75	·76	·77	·78	·79	·80	·81	·82	·83	·84	·85
°															
2	·710	·720	·730	·740	·750	·760	·770	·780	·790	·800	·810	·819	·829	·839	·849
4	·708	·718	·728	·738	·748	·758	·768	·778	·788	·798	·808	·818	·828	·838	·848
6	·706	·716	·726	·736	·746	·756	·766	·776	·786	·796	·806	·816	·825	·835	·845
8	·703	·713	·723	·733	·743	·753	·763	·772	·782	·792	·802	·812	·822	·832	·842
10	·699	·709	·719	·729	·739	·748	·758	·768	·778	·788	·798	·808	·817	·827	·837
11	·697	·707	·717	·726	·736	·746	·756	·766	·775	·785	·795	·805	·815	·825	·834
12	·694	·704	·714	·724	·734	·743	·753	·763	·773	·783	·792	·802	·812	·822	·831
13	·692	·702	·711	·721	·731	·741	·750	·760	·770	·779	·789	·799	·809	·818	·828
14	·689	·699	·708	·718	·728	·737	·747	·757	·767	·776	·786	·796	·805	·815	·825
15	·686	·695	·705	·715	·724	·734	·744	·753	·763	·773	·782	·792	·802	·811	·821
16	·682	·692	·702	·711	·721	·731	·740	·750	·759	·769	·779	·788	·798	·807	·817
17	·679	·689	·698	·708	·717	·727	·736	·746	·755	·765	·775	·784	·794	·803	·813
18	·675	·685	·694	·704	·713	·723	·732	·742	·751	·761	·770	·780	·789	·799	·808
19	·671	·681	·690	·700	·709	·719	·728	·738	·747	·756	·766	·775	·785	·794	·804
20	·667	·677	·686	·695	·705	·714	·724	·733	·742	·752	·761	·771	·780	·789	·799
21	·663	·672	·682	·691	·700	·710	·719	·728	·738	·747	·756	·766	·775	·784	·794
22	·658	·668	·677	·686	·695	·705	·714	·723	·732	·742	·751	·760	·770	·779	·788
23	·654	·663	·672	·681	·690	·700	·709	·718	·727	·736	·746	·755	·764	·773	·782
24	·649	·658	·667	·676	·685	·694	·703	·713	·722	·731	·740	·749	·758	·767	·777
25	·643	·653	·662	·671	·680	·689	·698	·707	·716	·725	·734	·743	·752	·761	·770
26	·638	·647	·656	·665	·674	·683	·692	·701	·710	·719	·728	·737	·746	·755	·764
27	·633	·642	·650	·659	·668	·677	·686	·695	·704	·713	·722	·731	·740	·748	·757
28	·627	·636	·645	·653	·662	·671	·680	·689	·698	·706	·715	·724	·733	·742	·751
29	·621	·630	·638	·647	·656	·665	·673	·682	·691	·700	·708	·717	·726	·735	·743
30	·615	·624	·632	·641	·650	·658	·667	·675	·684	·693	·701	·710	·719	·727	·736
31	·609	·617	·626	·634	·643	·651	·660	·669	·677	·686	·694	·703	·711	·720	·729
32	·602	·611	·619	·628	·636	·645	·653	·661	·670	·678	·687	·695	·704	·712	·721
33	·595	·604	·612	·621	·629	·637	·646	·654	·663	·671	·679	·688	·696	·704	·713
34	·589	·597	·605	·613	·622	·630	·638	·647	·655	·663	·672	·680	·688	·696	·705
35	·582	·590	·598	·606	·614	·623	·631	·639	·647	·655	·664	·672	·680	·688	·696
36	·574	·582	·591	·599	·607	·615	·623	·631	·639	·647	·655	·663	·671	·680	·688
37	·567	·575	·583	·591	·599	·607	·615	·623	·631	·639	·647	·655	·663	·671	·679
38	·559	·567	·575	·583	·591	·599	·607	·615	·623	·630	·638	·646	·654	·662	·670
39	·552	·560	·567	·575	·583	·591	·598	·606	·614	·622	·629	·637	·645	·653	·661
40	·544	·552	·559	·567	·575	·582	·590	·598	·605	·613	620	·628	·636	·643	·651
41	·536	·543	·551	·558	·566	·574	·581	·589	·596	·604	·611	·619	·626	·634	·642
42	·528	·535	·542	·550	·557	·565	·572	·580	·587	·595	·602	·609	·617	·624	·632
43	·519	·527	·534	·541	·549	·556	·563	·570	·578	·585	·592	·600	·607	·614	·622
44	·511	·518	·525	·532	·540	·547	·554	·561	·568	·575	·583	·590	·597	·604	·611
45	·502	·509	·516	·523	·530	·537	·544	·552	·559	·566	·573	·580	·587	·594	·601
46	·493	·500	·507	·514	·521	·528	·535	·542	·549	·556	·563	·570	·577	·584	·590
47	·484	·491	·498	·505	·511	·518	·525	·532	·539	·546	·552	·559	·566	·573	·580
48	·475	·482	·488	·495	·502	·509	·515	·522	·529	·535	·542	·549	·555	·562	·569
49	·466	·472	·479	·485	·492	·499	·505	·512	·518	·525	·531	·538	·545	·551	·558
50	·456	·463	·469	·476	·482	·489	·495	·501	·508	·514	·521	·527	·534	·540	·546
51	·447	·453	·459	·466	·472	·478	·485	·491	·497	·503	·510	·516	·522	·529	·535
52	·437	·443	·449	·456	·462	·468	·474	·480	·486	·493	·499	·505	·511	·517	·523
53	·427	·433	·439	·445	·451	·457	·463	·469	·475	·481	·487	·493	·500	·506	·512
54	·417	·423	·429	·435	·441	·447	·453	·458	·464	·470	·476	·482	·488	·494	·500
55	·407	·413	·419	·424	·430	·436	·442	·447	·453	·459	·465	·470	·476	·482	·488
56	·397	·403	·408	·414	·419	·425	·431	·436	·442	·447	·453	·459	·464	·470	·475
57	·387	·392	·398	·403	·408	·414	·419	·425	·430	·436	·441	·447	·452	·457	·463
58	·376	·382	·387	·392	·397	·403	·408	·413	·419	·424	·429	·435	·440	·445	·450
59	·366	·371	·376	·381	·386	·391	·397	·402	·407	·412	·417	·422	·427	·433	·438
60	·355	·360	·365	·370	·375	·380	·385	·390	·395	·400	·405	·410	·415	·420	·425
61	·344	·349	·354	·359	·364	·368	·373	·378	·383	·388	·393	·398	·402	·407	·412
62	·333	·338	·343	·347	·352	·357	·361	·366	·371	·376	·380	·385	·390	·394	·399
63	·322	·327	·331	·336	·340	·345	·350	·354	·359	·363	·368	·372	·377	·381	·386
64	·311	·316	·320	·324	·329	·333	·338	·342	·346	·351	·355	·359	·364	·368	·373
65	·300	·304	·309	·313	·317	·321	·325	·330	·334	·338	·342	·347	·351	·355	·359

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.														
	·86	·87	·88	·89	·90	·91	·92	·93	·94	·95	·96	·97	·98	·99	1·00
°															
2	·859	·869	·879	·889	·899	·909	·919	·929	·939	·949	·959	·969	·979	·989	·999
4	·858	·868	·878	·888	·898	·908	·918	·928	·938	·948	·958	·968	·978	·988	·998
6	·855	·865	·875	·885	·895	·905	·915	·925	·935	·945	·955	·965	·975	·985	·995
8	·852	·862	·871	·881	·891	·901	·911	·921	·931	·941	·951	·961	·970	·980	·990
10	·847	·857	·867	·876	·886	·896	·906	·916	·926	·936	·945	·955	·965	·975	·985
11	·844	·854	·864	·874	·883	·893	·903	·913	·923	·933	·942	·952	·962	·972	·982
12	·841	·851	·861	·871	·880	·890	·900	·910	·919	·929	·939	·949	·959	·968	·978
13	·838	·848	·857	·867	·877	·887	·896	·906	·916	·926	·935	·945	·955	·965	·974
14	·834	·844	·854	·864	·873	·883	·893	·902	·912	·922	·931	·941	·951	·961	·970
15	·831	·840	·850	·860	·869	·879	·889	·898	·908	·918	·927	·937	·947	·956	·966
16	·827	·836	·846	·856	·865	·875	·884	·894	·904	·913	·923	·932	·942	·952	·961
17	·822	·832	·842	·851	·861	·870	·880	·889	·899	·908	·918	·928	·937	·947	·956
18	·818	·827	·837	·846	·856	·865	·875	·884	·894	·904	·913	·923	·932	·942	·951
19	·813	·823	·832	·842	·851	·860	·870	·879	·889	·898	·908	·917	·927	·936	·946
20	·808	·818	·827	·836	·846	·855	·865	·874	·883	·893	·902	·912	·921	·930	·940
21	·803	·812	·822	·831	·840	·850	·859	·868	·878	·887	·896	·906	·915	·924	·934
22	·797	·807	·816	·825	·834	·844	·853	·862	·872	·881	·890	·899	·909	·918	·927
23	·792	·801	·810	·819	·828	·838	·847	·856	·865	·874	·884	·893	·902	·911	·921
24	·786	·795	·804	·813	·822	·831	·840	·850	·859	·868	·877	·886	·895	·904	·914
25	·779	·788	·798	·807	·816	·825	·834	·843	·852	·861	·870	·879	·888	·897	·906
26	·773	·782	·791	·800	·809	·818	·827	·836	·845	·854	·863	·872	·881	·890	·899
27	·766	·775	·784	·793	·802	·811	·820	·829	·838	·846	·855	·864	·873	·882	·891
28	·759	·768	·777	·786	·795	·803	·812	·821	·830	·839	·848	·856	·865	·874	·883
29	·752	·761	·770	·778	·787	·796	·805	·813	·822	·831	·840	·848	·857	·866	·875
30	·745	·753	·762	·771	·779	·788	·797	·805	·814	·823	·831	·840	·849	·857	·866
31	·737	·746	·754	·763	·771	·780	·789	·797	·806	·814	·823	·831	·840	·849	·857
32	·729	·738	·746	·755	·763	·772	·780	·789	·797	·806	·814	·823	·831	·840	·848
33	·721	·730	·738	·746	·755	·763	·772	·780	·788	·797	·805	·814	·822	·830	·839
34	·713	·721	·730	·738	·746	·754	·763	·771	·779	·788	·796	·804	·812	·821	·829
35	·704	·713	·721	·729	·737	·745	·754	·762	·770	·778	·786	·795	·803	·811	·819
36	·696	·704	·712	·720	·728	·736	·744	·752	·760	·769	·777	·785	·793	·801	·809
37	·687	·695	·703	·711	·719	·727	·735	·743	·751	·759	·767	·775	·783	·791	·799
38	·678	·686	·693	·701	·709	·717	·725	·733	·741	·749	·756	·764	·772	·780	·788
39	·668	·676	·684	·692	·699	·707	·715	·723	·731	·738	·746	·754	·762	·769	·777
40	·659	·666	·674	·682	·689	·697	·705	·712	·720	·728	·735	·743	·751	·758	·766
41	·649	·657	·664	·672	·679	·687	·694	·702	·709	·717	·725	·732	·740	·747	·755
42	·639	·647	·654	·661	·669	·676	·684	·691	·699	·706	·713	·721	·728	·736	·743
43	·629	·636	·644	·651	·658	·666	·673	·680	·687	·695	·702	·709	·717	·724	·731
44	·619	·626	·633	·640	·647	·655	·662	·669	·676	·683	·691	·698	·705	·712	·719
45	·608	·615	·622	·629	·636	·643	·651	·658	·665	·672	·679	·686	·693	·700	·707
46	·597	·604	·611	·618	·625	·632	·639	·646	·653	·660	·667	·674	·681	·688	·695
47	·587	·593	·600	·607	·614	·621	·627	·634	·641	·648	·655	·662	·668	·675	·682
48	·575	·582	·589	·596	·602	·609	·616	·622	·629	·636	·642	·649	·656	·662	·669
49	·564	·571	·577	·584	·590	·597	·604	·610	·617	·623	·630	·636	·643	·649	·656
50	·553	·559	·566	·572	·579	·585	·591	·598	·604	·611	·617	·624	·630	·636	·643
51	·541	·548	·554	·560	·566	·573	·579	·585	·592	·598	·604	·610	·617	·623	·629
52	·529	·536	·542	·548	·554	·560	·566	·573	·579	·585	·591	·597	·603	·610	·616
53	·518	·524	·530	·536	·542	·548	·554	·560	·566	·572	·578	·584	·590	·596	·602
54	·505	·511	·517	·523	·529	·535	·541	·547	·553	·558	·564	·570	·576	·582	·588
55	·493	·499	·505	·510	·516	·522	·528	·533	·539	·545	·551	·556	·562	·568	·574
56	·481	·486	·492	·498	·503	·509	·514	·520	·526	·531	·537	·542	·548	·554	·559
57	·468	·474	·479	·485	·490	·496	·501	·507	·512	·517	·523	·528	·534	·539	·545
58	·456	·461	·466	·472	·477	·482	·488	·493	·498	·503	·509	·514	·519	·525	·530
59	·443	·448	·453	·458	·464	·469	·474	·479	·484	·489	·494	·500	·505	·510	·515
60	·430	·435	·440	·445	·450	·455	·460	·465	·470	·475	·480	·485	·490	·495	·500
61	·417	·422	·427	·431	·436	·441	·446	·451	·456	·461	·465	·470	·475	·480	·485
62	·404	·408	·413	·418	·423	·427	·432	·437	·441	·446	·451	·455	·460	·465	·469
63	·390	·395	·400	·404	·409	·413	·418	·422	·427	·431	·436	·440	·445	·449	·454
64	·377	·381	·386	·390	·395	·399	·403	·408	·412	·416	·421	·425	·430	·434	·438
65	·363	·368	·372	·376	·380	·385	·389	·393	·397	·401	·406	·410	·414	·418	·423

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.															
	·10	·11	·12	·13	·14	·15	·16	·17	·18	·19	·20	·21	·22	·23	·24	·25
°																
65	·042	·046	·051	·055	·059	·063	·068	·072	·076	·080	·085	·089	·093	·097	·101	·106
66	·041	·045	·049	·053	·057	·061	·065	·069	·073	·077	·081	·085	·089	·094	·098	·102
67	·039	·043	·047	·051	·055	·059	·063	·066	·070	·074	·078	·082	·086	·090	·094	·098
68	·037	·041	·045	·049	·052	·056	·060	·064	·067	·071	·075	·079	·082	·086	·090	·094
69	·036	·039	·043	·047	·050	·054	·057	·061	·065	·068	·072	·075	·079	·082	·086	·090
70	·034	·038	·041	·044	·048	·051	·055	·058	·062	·065	·068	·072	·075	·079	·082	·086
71	·033	·036	·039	·042	·046	·049	·052	·055	·059	·062	·065	·068	·072	·075	·078	·081
72	·031	·034	·037	·040	·043	·046	·049	·053	·056	·059	·062	·065	·068	·071	·074	·077
73	·029	·032	·035	·038	·041	·044	·047	·050	·053	·056	·058	·061	·064	·067	·070	·073
74	·028	·030	·033	·036	·039	·041	·044	·047	·050	·052	·055	·058	·061	·063	·066	·069
75	·026	·028	·031	·034	·036	·039	·041	·044	·047	·049	·052	·054	·057	·060	·062	·065
76	·024	·027	·029	·031	·034	·036	·039	·041	·044	·046	·048	·051	·053	·056	·058	·060
77	·022	·025	·027	·029	·031	·034	·036	·038	·040	·043	·045	·047	·049	·052	·054	·056
78	·021	·023	·025	·027	·029	·031	·033	·035	·037	·040	·042	·044	·046	·048	·050	·052
79	·019	·021	·023	·025	·027	·029	·031	·032	·034	·036	·038	·040	·042	·044	·046	·048
80	·017	·019	·021	·023	·024	·026	·028	·030	·031	·033	·035	·036	·038	·040	·042	·043
81	·016	·017	·019	·020	·022	·023	·025	·027	·028	·030	·031	·033	·034	·036	·038	·039
82	·014	·015	·017	·018	·019	·021	·022	·024	·025	·026	·028	·029	·031	·032	·033	·035
83	·012	·013	·015	·016	·017	·018	·019	·021	·022	·023	·024	·026	·027	·028	·029	·030
84	·010	·011	·013	·014	·015	·016	·017	·018	·019	·020	·021	·022	·023	·024	·025	·026
85	·009	·010	·010	·011	·012	·013	·014	·015	·016	·017	·017	·018	·019	·020	·021	·022
86	·007	·008	·008	·009	·010	·010	·011	·012	·013	·013	·014	·015	·015	·016	·017	·017
87	·005	·006	·006	·007	·007	·008	·008	·009	·009	·010	·010	·011	·012	·012	·013	·013
88	·003	·004	·004	·005	·005	·005	·006	·006	·006	·007	·007	·007	·008	·008	·008	·009
89	·002	·002	·002	·002	·002	·003	·003	·003	·003	·003	·003	·004	·004	·004	·004	·004

Lat.	DIFFERENCE OF LONGITUDE.															
	·25	·26	·27	·28	·29	·30	·31	·32	·33	·34	·35	·36	·37	·38	·39	·40
°																
65	·106	·110	·114	·118	·123	·127	·131	·135	·139	·144	·148	·152	·156	·161	·165	·169
66	·102	·106	·110	·114	·118	·122	·126	·130	·134	·138	·142	·146	·150	·155	·159	·163
67	·098	·102	·105	·109	·113	·117	·121	·125	·129	·133	·137	·141	·145	·148	·152	·156
68	·094	·097	·101	·105	·109	·112	·116	·120	·124	·127	·131	·135	·139	·142	·146	·150
69	·090	·093	·097	·100	·104	·108	·111	·115	·118	·122	·125	·129	·133	·136	·140	·143
70	·086	·089	·092	·096	·099	·103	·106	·109	·113	·116	·120	·123	·127	·130	·133	·137
71	·081	·085	·088	·091	·094	·098	·101	·104	·107	·111	·114	·117	·120	·124	·127	·130
72	·077	·080	·083	·087	·090	·093	·096	·099	·102	·105	·108	·111	·114	·117	·121	·124
73	·073	·076	·079	·082	·085	·088	·091	·094	·096	·099	·102	·105	·108	·111	·114	·117
74	·069	·072	·074	·077	·080	·083	·085	·088	·091	·094	·096	·099	·102	·105	·107	·110
75	·065	·067	·070	·072	·075	·078	·080	·083	·085	·088	·091	·093	·096	·098	·101	·104
76	·060	·063	·065	·068	·070	·073	·075	·077	·080	·082	·085	·087	·090	·092	·094	·097
77	·057	·058	·061	·063	·065	·067	·070	·072	·074	·076	·079	·081	·083	·085	·088	·090
78	·052	·054	·056	·058	·060	·062	·064	·067	·069	·071	·073	·075	·077	·079	·081	·083
79	·048	·050	·052	·053	·055	·057	·059	·061	·063	·065	·067	·069	·071	·073	·074	·076
80	·043	·045	·047	·049	·050	·052	·054	·056	·057	·059	·061	·063	·064	·066	·068	·069
81	·039	·041	·042	·044	·045	·047	·048	·050	·052	·053	·055	·056	·058	·059	·061	·063
82	·035	·036	·038	·039	·040	·042	·043	·045	·046	·047	·049	·050	·051	·053	·054	·056
83	·030	·032	·033	·034	·035	·037	·038	·039	·040	·041	·043	·044	·045	·046	·048	·049
84	·026	·027	·028	·029	·030	·031	·032	·033	·034	·036	·037	·038	·039	·040	·041	·042
85	·022	·023	·024	·024	·025	·026	·027	·028	·029	·030	·031	·031	·032	·033	·034	·035
86	·017	·018	·019	·020	·020	·021	·022	·022	·023	·024	·024	·025	·026	·027	·027	·028
87	·013	·014	·014	·015	·015	·016	·016	·017	·017	·018	·018	·019	·019	·020	·020	·021
88	·009	·009	·009	·010	·010	·010	·011	·011	·012	·012	·012	·013	·013	·013	·014	·014
89	·004	·005	·005	·005	·005	·005	·005	·006	·006	·006	·006	·006	·006	·007	·007	·007

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.															
	·40	·41	·42	·43	·44	·45	·46	·47	·48	·49	·50	·51	·52	·53	·54	·55
65°	·169	·173	·177	·182	·186	·190	·194	·199	·203	·207	·211	·216	·220	·224	·228	·232
66	·163	·167	·171	·175	·179	·183	·187	·191	·195	·199	·203	·207	·212	·216	·220	·224
67	·156	·160	·164	·168	·172	·176	·180	·184	·188	·191	·195	·199	·203	·207	·211	·215
68	·150	·154	·157	·161	·165	·169	·172	·176	·180	·184	·187	·191	·195	·199	·202	·206
69	·143	·147	·151	·154	·158	·161	·165	·168	·172	·176	·179	·183	·186	·190	·194	·197
70	·137	·140	·144	·147	·150	·154	·157	·161	·164	·168	·171	·174	·178	·181	·185	·188
71	·130	·133	·137	·140	·143	·147	·150	·153	·156	·160	·163	·166	·169	·173	·176	·179
72	·124	·127	·130	·133	·136	·139	·142	·145	·148	·151	·155	·158	·161	·164	·167	·170
73	·117	·120	·123	·126	·129	·132	·134	·137	·140	·143	·146	·149	·152	·155	·158	·161
74	·110	·113	·116	·119	·121	·124	·127	·130	·132	·135	·138	·141	·143	·146	·149	·152
75	·104	·106	·109	·111	·114	·116	·119	·122	·124	·127	·129	·132	·135	·137	·140	·142
76	·097	·099	·102	·104	·106	·109	·111	·114	·116	·119	·121	·123	·126	·128	·131	·133
77	·090	·092	·094	·097	·099	·101	·103	·106	·108	·110	·112	·115	·117	·119	·121	·124
78	·083	·085	·087	·089	·091	·094	·096	·098	·100	·102	·104	·106	·108	·110	·112	·114
79	·076	·078	·080	·082	·084	·086	·088	·090	·092	·193	·095	·097	·099	·101	·103	·105
80	·069	·071	·073	·075	·076	·078	·080	·082	·083	·085	·087	·089	·090	·092	·094	·096
81	·063	·064	·066	·067	·069	·070	·072	·074	·075	·077	·078	·080	·081	·083	·084	·086
82	·056	·057	·058	·060	·061	·063	·064	·065	·067	·068	·070	·071	·072	·074	·075	·077
83	·049	·050	·051	·052	·054	·055	·056	·057	·058	·060	·061	·062	·063	·065	·066	·067
84	·042	·043	·044	·045	·046	·047	·048	·049	·050	·051	·052	·053	·054	·055	·056	·057
85	·035	·036	·037	·037	·038	·039	·040	·041	·042	·043	·044	·044	·045	·046	·047	·048
86	·028	·029	·029	·030	·031	·031	·032	·033	·033	·034	·035	·036	·036	·037	·038	·038
87	·021	·021	·022	·023	·023	·024	·024	·025	·025	·026	·026	·027	·027	·028	·028	·029
88	·014	·014	·015	·015	·015	·016	·016	·016	·017	·017	·017	·018	·018	·018	·019	·019
89	·007	·007	·007	·008	·008	·008	·008	·008	·008	·009	·009	·009	·009	·009	·009	·010

Lat.	DIFFERENCE OF LONGITUDE															
	·55	·56	·57	·58	·59	·60	·61	·62	·63	·64	·65	·66	·67	·58	·69	·70
65°	·232	·237	·241	·245	·249	·254	·258	·262	·266	·270	·275	·279	·283	·287	·292	·296
66	·224	·228	·232	·236	·240	·244	·248	·252	·256	·260	·264	·268	·273	·277	·281	·285
67	·215	·219	·223	·227	·231	·234	·238	·242	·246	·250	·254	·258	·262	·266	·270	·274
68	·206	·210	·214	·217	·221	·225	·229	·232	·236	·240	·243	·247	·251	·255	·258	·262
69	·197	·201	·204	·208	·211	·215	·219	·222	·226	·229	·233	·237	·240	·244	·247	·251
70	·188	·192	·195	·198	·202	·205	·209	·212	·215	·219	·222	·226	·229	·233	·236	·239
71	·179	·182	·186	·189	·192	·195	·199	·202	·205	·208	·212	·215	·218	·221	·225	·228
72	·170	·173	·176	·179	·182	·185	·189	·192	·195	·198	·201	·204	·207	·210	·213	·216
73	·161	·164	·167	·170	·172	·175	·178	·181	·184	·187	·190	·193	·196	·199	·202	·205
74	·152	·154	·157	·160	·163	·165	·168	·171	·174	·176	·179	·182	·185	·187	·190	·193
75	·142	·145	·148	·150	·153	·155	·158	·160	·163	·166	·168	·171	·173	·176	·179	·181
76	·133	·135	·138	·140	·143	·145	·148	·150	·152	·155	·157	·160	·162	·165	·167	·169
77	·124	·126	·128	·130	·133	·135	·137	·139	·142	·144	·146	·148	·151	·153	·155	·157
78	·114	·116	·119	·121	·123	·125	·127	·129	·131	·133	·135	·137	·139	·141	·143	·146
79	·105	·107	·109	·111	·113	·114	·116	·118	·120	·122	·124	·126	·128	·130	·132	·134
80	·096	·097	·099	·101	·102	·104	·106	·108	·109	·111	·113	·115	·116	·118	·120	·122
81	·086	·088	·089	·091	·092	·094	·095	·097	·099	·100	·102	·103	·105	·106	·108	·110
82	·077	·078	·079	·081	·082	·084	·085	·086	·088	·089	·090	·092	·093	·095	·096	·097
83	·067	·068	·069	·071	·072	·073	·074	·076	·077	·078	·079	·080	·082	·083	·084	·085
84	·057	·059	·060	·061	·062	·063	·064	·065	·066	·067	·068	·069	·070	·071	·072	·073
85	·048	·049	·050	·051	·051	·052	·053	·054	·055	·056	·057	·058	·058	·059	·060	·161
86	·038	·039	·040	·040	·041	·042	·043	·043	·044	·045	·045	·046	·047	·047	·048	·049
87	·029	·029	·030	·030	·031	·031	·032	·032	·033	·033	·034	·035	·035	·036	·036	·037
88	·019	·020	·020	·020	·021	·021	·021	·022	·022	·022	·023	·023	·023	·024	·024	·024
89	·010	·010	·010	·010	·010	·010	·011	·011	·011	·011	·011	·012	·012	·012	·012	·012

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.															
	·70	·71	·72	·73	·74	·75	·76	·77	·78	·79	·80	·81	·82	·83	·84	·85
65°	·296	·300	·304	·309	·313	·317	·321	·325	·330	·334	·338	·342	·347	·351	·355	·359
66	·285	·289	·293	·297	·301	·305	·309	·313	·317	·321	·325	·329	·334	·338	·342	·346
67	·274	·277	·281	·285	·289	·293	·297	·301	·305	·309	·313	·316	·320	·324	·328	·332
68	·262	·266	·270	·273	·277	·281	·285	·288	·292	·296	·300	·303	·307	·311	·315	·318
69	·251	·254	·258	·262	·265	·269	·272	·276	·280	·283	·287	·290	·294	·297	·301	·305
70	·239	·243	·246	·250	·253	·257	·260	·263	·267	·270	·274	·277	·280	·284	·287	·291
71	·228	·231	·234	·238	·241	·244	·247	·251	·254	·257	·260	·264	·267	·270	·273	·277
72	·216	·219	·222	·226	·229	·232	·235	·238	·241	·244	·247	·250	·253	·256	·260	·263
73	·205	·208	·211	·213	·216	·219	·222	·225	·228	·231	·234	·237	·240	·243	·246	·249
74	·193	·196	·198	·201	·204	·207	·209	·212	·215	·218	·221	·223	·226	·229	·232	·234
75	·181	·184	·186	·189	·192	·194	·197	·199	·202	·204	·207	·210	·212	·215	·217	·220
76	·169	·172	·174	·177	·179	·181	·184	·186	·189	·191	·194	·196	·198	·201	·203	·206
77	·157	·160	·162	·164	·166	·169	·171	·173	·175	·178	·180	·182	·184	·187	·189	·191
78	·146	·148	·150	·152	·154	·156	·158	·160	·162	·164	·166	·168	·170	·173	·175	·177
79	·134	·135	·137	·139	·141	·143	·145	·147	·149	·151	·153	·155	·156	·158	·160	·162
80	·122	·123	·125	·127	·128	·130	·132	·134	·135	·137	·139	·141	·142	·144	·146	·148
81	·110	·111	·113	·114	·116	·117	·119	·120	·122	·124	·125	·127	·128	·130	·131	·133
82	·097	·099	·100	·102	·103	·104	·106	·107	·109	·110	·111	·113	·114	·116	·117	·118
83	·085	·087	·088	·089	·090	·091	·093	·094	·095	·096	·097	·099	·100	·101	·102	·104
84	·073	·074	·075	·076	·077	·078	·079	·080	·082	·083	·084	·085	·086	·087	·088	·089
85	·061	·062	·063	·064	·064	·065	·066	·067	·068	·069	·070	·071	·071	·072	·073	·074
86	·049	·050	·050	·051	·052	·052	·053	·054	·054	·055	·056	·057	·057	·058	·059	·059
87	·037	·037	·038	·038	·039	·039	·040	·040	·041	·041	·042	·042	·043	·043	·044	·044
88	·024	·025	·025	·025	·026	·026	·027	·027	·027	·028	·028	·028	·029	·029	·029	·030
89	·012	·012	·013	·013	·013	·013	·013	·013	·014	·014	·014	·014	·014	·014	·015	·015

Lat.	DIFFERENCE OF LONGITUDE.															
	·85	·86	·87	·88	·89	·90	·91	·92	·93	·94	·95	·96	·97	·98	·99	1·00
65°	·359	·363	·368	·372	·376	·380	·385	·389	·393	·397	·401	·406	·410	·414	·418	·423
66	·346	·350	·354	·358	·362	·366	·370	·374	·378	·382	·386	·390	·395	·399	·403	·407
67	·332	·336	·340	·344	·348	·352	·356	·359	·363	·367	·371	·375	·379	·383	·387	·391
68	·318	·322	·326	·330	·333	·337	·341	·345	·348	·352	·356	·360	·363	·367	·371	·375
69	·305	·308	·312	·315	·319	·323	·326	·330	·333	·337	·340	·344	·348	·351	·355	·358
70	·291	·294	·298	·301	·304	·308	·311	·315	·318	·321	·325	·328	·332	·335	·339	·342
71	·277	·280	·283	·287	·290	·293	·296	·300	·303	·306	·309	·313	·316	·319	·322	·326
72	·263	·266	·269	·272	·275	·278	·281	·284	·287	·290	·294	·297	·300	·303	·306	·309
73	·249	·251	·254	·257	·260	·263	·266	·269	·272	·275	·278	·281	·284	·287	·289	·292
74	·234	·237	·240	·243	·245	·248	·251	·254	·256	·259	·262	·265	·267	·270	·273	·276
75	·220	·223	·225	·228	·230	·233	·236	·238	·241	·243	·246	·248	·251	·254	·256	·259
76	·206	·208	·210	·213	·215	·218	·220	·223	·225	·227	·230	·232	·235	·237	·240	·242
77	·191	·193	·196	·198	·200	·202	·205	·207	·209	·211	·214	·216	·218	·220	·223	·225
78	·177	·179	·181	·183	·185	·187	·189	·191	·193	·195	·198	·200	·202	·204	·206	·208
79	·162	·164	·166	·168	·170	·172	·174	·176	·177	·179	·181	·183	·185	·187	·189	·191
80	·148	·149	·151	·153	·155	·156	·158	·160	·161	·163	·165	·167	·168	·170	·172	·174
81	·133	·135	·136	·138	·139	·141	·142	·144	·145	·147	·149	·150	·152	·153	·155	·156
82	·118	·120	·121	·122	·124	·125	·127	·128	·129	·131	·132	·134	·135	·136	·138	·139
83	·104	·105	·106	·107	·108	·110	·111	·112	·113	·115	·116	·117	·118	·119	·121	·122
84	·089	·090	·091	·092	·093	·094	·095	·096	·097	·098	·099	·100	·101	·102	·103	·105
85	·074	·075	·076	·077	·078	·078	·079	·080	·081	·082	·083	·084	·085	·085	·086	·087
86	·059	·060	·061	·061	·062	·063	·063	·064	·065	·066	·066	·067	·068	·068	·069	·070
87	·044	·045	·046	·046	·047	·047	·048	·048	·049	·049	·050	·050	·051	·051	·052	·052
88	·030	·030	·030	·031	·031	·031	·032	·032	·032	·033	·033	·034	·034	·034	·035	·035
89	·015	·015	·015	·015	·016	·016	·016	·016	·016	·016	·017	·017	·017	·017	·017	·017

Traverse Table.

SHOWING DIFFERENCE OF LONGITUDE AND CORRESPONDING DEPARTURE.

Lat.	DIFFERENCE OF LONGITUDE.															
	1·00	1·01	1·02	1·03	1·04	1·05	1·06	1·07	1·08	1·09	1·10	1·11	1·12	1·13	1·14	1·15
°																
65	·423	·427	·431	·435	·440	·444	·448	·452	·456	·461	·465	·469	·473	·478	·482	·486
66	·407	·411	·415	·419	·423	·427	·431	·435	·439	·443	·447	·451	·456	·460	·464	·468
67	·391	·395	·399	·402	·406	·410	·414	·418	·422	·426	·430	·434	·438	·442	·445	·449
68	·375	·378	·382	·386	·390	·393	·397	·401	·405	·408	·412	·416	·420	·423	·427	·431
69	·358	·362	·366	·369	·373	·376	·380	·383	·387	·391	·394	·398	·401	·405	·409	·412
70	·342	·345	·349	·352	·356	·359	·363	·366	·369	·373	·376	·380	·383	·386	·390	·393
71	·326	·329	·332	·335	·339	·342	·345	·348	·352	·355	·358	·361	·365	·368	·371	·374
72	·309	·312	·315	·318	·321	·324	·328	·331	·334	·337	·340	·343	·346	·349	·352	·355
73	·292	·295	·298	·301	·304	·307	·310	·313	·316	·319	·322	·325	·327	·330	·333	·336
74	·276	·278	·281	·284	·287	·289	·292	·295	·298	·300	·303	·306	·309	·311	·314	·317
75	·259	·261	·264	·267	·269	·272	·274	·277	·280	·282	·285	·287	·290	·292	·295	·298
76	·242	·244	·247	·249	·252	·254	·256	·259	·261	·264	·266	·269	·271	·273	·276	·278
77	·225	·227	·229	·232	·234	·236	·238	·241	·243	·245	·247	·250	·252	·254	·256	·259
78	·208	·210	·212	·214	·216	·218	·220	·222	·225	·227	·229	·231	·233	·235	·237	·239
79	·191	·193	·195	·197	·198	·200	·202	·204	·206	·208	·210	·212	·214	·216	·218	·219
80	·174	·175	·177	·179	·181	·182	·184	·186	·188	·189	·191	·193	·194	·196	·198	·200
81	·156	·158	·160	·161	·163	·164	·166	·167	·169	·171	·172	·174	·175	·177	·178	·180
82	·139	·141	·142	·143	·145	·146	·148	·149	·150	·152	·153	·154	·156	·157	·159	·160
83	·122	·123	·124	·126	·127	·128	·129	·130	·132	·133	·134	·135	·136	·138	·139	·140
84	·105	·106	·107	·108	·109	·110	·111	·112	·113	·114	·115	·116	·117	·118	·119	·120
85	·087	·088	·089	·090	·091	·092	·092	·093	·094	·095	·096	·097	·098	·098	·099	·100
86	·070	·070	·071	·072	·073	·073	·074	·075	·075	·076	·077	·077	·078	·079	·080	·080
87	·052	·053	·053	·054	·054	·055	·055	·056	·057	·057	·058	·058	·059	·059	·060	·060
88	·035	·035	·036	·036	·036	·037	·037	·037	·038	·038	·038	·039	·039	·039	·040	·040
89	·017	·018	·018	·018	·018	·018	·018	·019	·019	·019	·019	·019	·020	·020	·020	·020

Lat.	DIFFERENCE OF LONGITUDE.															
	1·15	1·16	1·17	1·18	1·19	1·20	1·21	1·22	1·23	1·24	1·25	1·26	1·27	1·28	1·29	1·30
°																
65	·486	·490	·494	·499	·503	·507	·511	·516	·520	·524	·528	·532	·537	·541	·545	·549
66	·468	·472	·476	·480	·484	·488	·492	·496	·500	·504	·508	·512	·517	·521	·525	·529
67	·449	·453	·457	·461	·465	·469	·473	·477	·481	·485	·488	·492	·496	·500	·504	·508
68	·431	·435	·438	·442	·446	·450	·453	·457	·461	·465	·468	·472	·476	·479	·483	·487
69	·412	·416	·419	·423	·426	·430	·434	·437	·441	·444	·448	·452	·455	·459	·462	·466
70	·393	·397	·400	·404	·407	·410	·414	·417	·421	·424	·428	·431	·434	·438	·441	·445
71	·374	·378	·381	·384	·387	·391	·394	·397	·400	·404	·407	·410	·413	·417	·420	·423
72	·355	·358	·362	·365	·368	·371	·374	·377	·380	·383	·386	·389	·392	·396	·399	·402
73	·336	·339	·342	·345	·348	·351	·354	·357	·360	·363	·365	·368	·371	·374	·377	·380
74	·317	·320	·322	·325	·328	·331	·334	·336	·339	·342	·345	·347	·350	·353	·356	·358
75	·298	·300	·303	·305	·308	·311	·313	·316	·318	·321	·324	·326	·329	·331	·334	·336
76	·278	·281	·283	·285	·288	·290	·293	·295	·298	·300	·302	·305	·307	·310	·312	·314
77	·259	·261	·263	·265	·268	·270	·272	·274	·277	·279	·281	·283	·286	·288	·290	·292
78	·239	·241	·243	·245	·247	·249	·252	·254	·256	·258	·260	·262	·264	·266	·268	·270
79	·219	·221	·223	·225	·227	·229	·231	·233	·235	·237	·239	·240	·242	·244	·246	·248
80	·200	·201	·203	·205	·207	·208	·210	·212	·214	·215	·217	·219	·221	·222	·224	·226
81	·180	·181	·183	·185	·186	·188	·189	·191	·192	·194	·196	·197	·199	·200	·202	·203
82	·160	·161	·163	·164	·166	·167	·168	·170	·171	·173	·174	·175	·177	·178	·180	·181
83	·140	·141	·143	·144	·145	·146	·147	·149	·150	·151	·152	·154	·155	·156	·157	·158
84	·120	·121	·122	·123	·124	·125	·126	·128	·129	·130	·131	·132	·133	·134	·135	·136
85	·100	·101	·102	·103	·104	·105	·105	·106	·107	·108	·109	·110	·111	·112	·112	·113
86	·080	·081	·082	·082	·083	·084	·084	·085	·086	·086	·087	·088	·089	·089	·090	·091
87	·060	·061	·061	·062	·062	·063	·063	·064	·064	·065	·065	·066	·066	·067	·068	·068
88	·040	·040	·041	·041	·042	·042	·042	·043	·043	·043	·044	·044	·044	·045	·045	·045
89	·020	·020	·020	·021	·021	·021	·021	·021	·021	·022	·022	·022	·022	·022	·022	·023

Table C[1].

AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	°	′	°	′	°	′	°	′	°	′	°	′	°
·000	90·0	·112	83·6	·227	77·2	·348	70·8	·479	64·4	·627	57·9	·798	51·4
·002	89·9	·114	·5	·229	·1	·350	·7	·481	·3	·630	·8	·801	·3
·003	·8	·116	·4	·231	77·0	·352	·6	·483	·2	·632	·7	·804	·2
·005	·7	·117	·3	·233	76·9	·354	70·5	·486	·1	·635	·6	·807	·1
·007	·6	·119	·2	·235	·8	·356	·4	·488	64·0	·637	57·5	·810	51·0
·009	89·5	·121	·1	·236	·7	·358	·3	·490	63·9	·640	·4	·813	50·9
·010	·4	·123	83·0	·238	·6	·360	·2	·492	·8	·642	·3	·816	·8
·012	·3	·125	82·9	·240	76·5	·362	·1	·494	·7	·644	·2	·818	·7
·014	·2	·126	·8	·242	·4	·364	70·0	·496	·6	·647	·1	·821	·6
·016	·1	·128	·7	·244	·3	·366	69·9	·499	63·5	·649	57·0	·824	50·5
·017	89·0	·130	·6	·246	·2	·368	·8	·501	·4	·652	56·9	·827	·4
·019	88·9	·132	82·5	·248	·1	·370	·7	·503	·3	·654	·8	·830	·3
·021	·8	·133	·4	·249	76·0	·372	·6	·505	·2	·657	·7	·833	·2
·023	·7	·135	·3	·251	75·9	·374	69·5	·507	·1	·659	·6	·836	50·1
·024	·6	·137	·2	·253	·8	·376	·4	·510	63·0	·662	56·5	·839	50·0
·026	88·5	·139	·1	·255	·7	·378	·3	·512	62·9	·664	·4	·842	49·9
·028	·4	·141	82·0	·257	·6	·380	·2	·514	·8	·667	·3	·845	·8
·030	·3	·142	81·9	·259	75·5	·382	·1	·516	·7	·669	·2	·848	·7
·031	·2	·144	·8	·261	·4	·384	69·0	·518	·6	·672	·1	·851	·6
·033	·1	·146	·7	·262	·3	·386	68·9	·521	62·5	·674	56·0	·854	49·5
·035	88·0	·148	·6	·264	·2	·388	·8	·523	·4	·677	55·9	·857	·4
·037	87·9	·149	81·5	·266	·1	·390	·7	·525	·3	·680	·8	·860	·3
·038	·8	·151	·4	·268	75·0	·392	·6	·527	·2	·682	·7	·863	·2
·040	·7	·153	·3	·270	74·9	·394	68·5	·530	·1	·685	·6	·866	·1
·042	·6	·155	·2	·272	·8	·396	·4	·532	62·0	·687	55·5	·869	49·0
·044	87·5	·156	·1	·274	·7	·398	·3	·534	61·9	·690	·4	·872	48·9
·045	·4	·158	81·0	·275	·6	·400	·2	·536	·8	·692	·3	·875	·8
·047	·3	·160	80·9	·277	74·5	·402	·1	·538	·7	·695	·2	·878	·7
·049	·2	·162	·8	·279	·4	·404	68·0	·541	·6	·698	·1	·882	·6
·051	·1	·164	·7	·281	·3	·406	67·9	·543	61·5	·700	55·0	·885	48·5
·052	87·0	·166	·6	·283	·2	·408	·8	·545	·4	·703	54·9	·888	·4
·054	86·9	·167	80·5	·285	·1	·410	·7	·547	·3	·705	·8	·891	·3
·056	·8	·169	·4	·287	74·0	·412	·6	·550	·2	·708	·7	·894	·2
·058	·7	·171	·3	·289	73·9	·414	67·5	·552	·1	·711	·6	·897	·1
·059	·6	·173	·2	·290	·8	·416	·4	·554	61·0	·713	54·5	·900	48·0
·061	86·5	·175	·1	·292	·7	·418	·3	·557	60·9	·716	·4	·904	47·9
·063	·4	·176	80·0	·294	·6	·420	·2	·559	·8	·719	·3	·907	·8
·065	·3	·178	79·9	·296	73·5	·422	·1	·561	·7	·721	·2	·910	·7
·066	·2	·180	·8	·298	·4	·424	67·0	·563	·6	·724	·1	·913	·6
·068	·1	·182	·7	·300	·3	·427	66·9	·566	60·5	·727	54·0	·916	47·5
·070	86·0	·184	·6	·302	·2	·429	·8	·568	·4	·729	53·9	·919	·4
·072	85·9	·185	79·5	·304	·1	·431	·7	·570	·3	·732	·8	·923	·3
·073	·8	·187	·4	·306	73·0	·433	·6	·573	·2	·735	·7	·926	·2
·075	·7	·189	·3	·308	72·9	·435	66·5	·575	·1	·737	·6	·929	·1
·077	·6	·191	·2	·310	·8	·437	·4	·577	60·0	·740	53·5	·932	47·0
·079	85·5	·193	·1	·311	·7	·439	·3	·580	59·9	·743	·4	·936	46·9
·080	·4	·194	79·0	·313	·6	·441	·2	·582	·8	·745	·3	·939	·8
·082	·3	·196	78·9	·315	72·5	·443	·1	·584	·7	·748	·2	·942	·7
·084	·2	·198	·8	·317	·4	·445	66·0	·587	·6	·751	·1	·946	·6
·086	·1	·200	·7	·319	·3	·447	65·9	·589	59·5	·754	53·0	·949	46·5
·087	85·0	·202	·6	·321	·2	·449	·8	·591	·4	·756	52·9	·952	·4
·089	84·9	·203	·5	·323	·1	·452	·7	·594	·3	·759	·8	·956	·3
·091	·8	·205	·4	·325	72·0	·454	·6	·596	·2	·762	·7	·959	·2
·093	·7	·207	·3	·327	71·9	·456	65·5	·598	·1	·765	·6	·962	·1
·095	·6	·209	·2	·329	·8	·458	·4	·601	59·0	·767	52·5	·966	46·0
·096	84·5	·211	·1	·331	·7	·460	·3	·603	58·9	·770	·4	·969	45·9
·098	·4	·213	78·0	·333	·6	·462	·2	·606	·8	·773	·3	·972	·8
·100	·3	·214	77·9	·335	71·5	·464	·1	·608	·7	·776	·2	·976	·7
·102	·2	·216	·8	·336	·4	·466	65·0	·610	·6	·778	·1	·979	·6
·103	·1	·218	·7	·338	·3	·468	64·9	·613	58·5	·781	52·0	·983	45·5
·105	84·0	·220	·6	·340	·2	·471	·8	·615	·4	·784	51·9	·986	·4
·107	83·9	·222	77·5	·342	·1	·473	·7	·618	·3	·787	·8	·990	·3
·109	·8	·224	·4	·344	71·0	·475	·6	·620	·2	·790	·7	·993	·2
·110	·7	·225	·3	·346	70·9	·477	64·5	·622	·1	·793	·6	·996	·1
·112	·6	·227	·2	·348	·8	·479	·4	·625	58·0	·795	51·5	1·000	45·0

Table C'.

AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
1·000	45 0	1·038	43 55	1·078	42 51	1·119	41 47	1·162	40 43	1·207	39 39	1·253	38 35
1·001	44 59	1·039	54	1·079	42 50	1·120	46	1·163	42	1·207	38	1·254	34
1·001	58	1·040	53	1·079	49	1·120	41 45	1·163	41	1·208	37	1·255	33
1·002	57	1·040	52	1·080	48	1·121	44	1·164	40 40	1·209	36	1·256	32
1·002	56	1·041	51	1·080	47	1·122	43	1·165	39	1·209	39 35	1·256	31
1·003	44 55	1·042	43 50	1·081	46	1·122	42	1·165	38	1·210	34	1·257	38 30
1·003	54	1·042	49	1·082	42 45	1·123	41	1·166	37	1·211	33	1·258	29
1·004	53	1·043	48	1·082	44	1·124	41 40	1·167	36	1·212	32	1·259	28
1·005	52	1·043	47	1·083	43	1·124	39	1·167	40 35	1·212	31	1·259	27
1·005	51	1·044	46	1·084	42	1·125	38	1·168	34	1·213	39 30	1·260	26
1·006	44 50	1·045	43 45	1·084	41	1·126	37	1·169	33	1·214	29	1·261	38 25
1·006	49	1·045	44	1·085	42 40	1·126	36	1·169	32	1·214	28	1·262	24
1·007	48	1·046	43	1·086	39	1·127	41 35	1·170	31	1·215	27	1·262	23
1·008	47	1·046	42	1·086	38	1·128	34	1·171	40 30	1·216	26	1·263	22
1·008	46	1·047	41	1 087	37	1·128	33	1·171	29	1·217	39 25	1·264	21
1·009	44 45	1·048	43 40	1·087	36	1·129	32	1·172	28	1·217	24	1·265	38 20
1·009	44	1·048	39	1·088	42 35	1·130	31	1·173	27	1·218	23	1·265	19
1·010	43	1·049	38	1·089	34	1·130	41 30	1·174	26	1·219	22	1·266	18
1·010	42	1·049	37	1·089	33	1·131	29	1·174	40 25	1·220	21	1·267	17
1·011	41	1·050	36	1·090	32	1·132	28	1·175	24	1·220	39 20	1·268	16
1·012	44 40	1·051	43 35	1·091	31	1·132	27	1·176	23	1·221	19	1·268	38 15
1·012	39	1·051	34	1·091	42 30	1·133	26	1·176	22	1·222	18	1·269	14
1·013	38	1·052	33	1·092	29	1·134	41 25	1·177	21	1·222	17	1·270	13
1·013	37	1·053	32	1·093	28	1·134	24	1·178	40 20	1·223	16	1·271	12
1·014	36	1·053	31	1·093	27	1·135	23	1·178	19	1·224	39 15	1·271	11
1·015	44 35	1·054	43 30	1·094	26	1·136	22	1·179	18	1·225	14	1·272	38 10
1·015	34	1·054	29	1·094	42 25	1·136	21	1·180	17	1·226	13	1·273	9
1·016	33	1·055	28	1·095	24	1·137	41 20	1·181	16	1·226	12	1·274	8
1·016	32	1·056	27	1·096	23	1·137	19	1·181	40 15	1·227	11	1·275	7
1·017	31	1·056	26	1·096	22	1·138	18	1·182	14	1·228	39 10	1·275	6
1·018	44 30	1·057	43 25	1·097	21	1·139	17	1·183	13	1·228	9	1·276	38 5
1·018	29	1·057	24	1·098	42 20	1·140	16	1·183	12	1·229	8	1·277	4
1·019	28	1·058	23	1·098	19	1·140	41 15	1·184	11	1·230	7	1·278	3
1·019	27	1·059	22	1·099	18	1·141	14	1·185	40 10	1·230	6	1·278	2
1·020	26	1·059	21	1·100	17	1·142	13	1·185	9	1·231	39 5	1·279	1
1·021	44 25	1·060	43 20	1·100	16	1·142	12	1·186	8	1·232	4	1·280	38 0
1·021	24	1·061	19	1·101	42 15	1·143	11	1·187	7	1·233	3	1·281	37 59
1·022	23	1·061	18	1·102	14	1·144	41 10	1·187	6	2·233	2	1·281	58
1·022	22	1·062	17	1·102	13	1·144	9	1·188	40 5	1·234	1	1·282	57
1·023	21	1·062	16	1·103	12	1·145	8	1·189	4	1·235	39 0	1·283	56
1·023	44 20	1·063	43 15	1·103	11	1·146	7	1·190	3	1·236	38 59	1·284	37 55
1·024	19	1·064	14	1·104	42 10	1·146	6	1·190	2	1·236	58	1·285	54
1·025	18	1·064	13	1·105	9	1·147	41 5	1·191	1	1·237	57	1·285	53
1·025	17	1·065	12	1·105	8	1·148	4	1·192	40 0	1·238	56	1·286	52
1·026	16	1·065	11	1·106	7	1·148	3	1·192	39 59	1·239	38 55	1·287	51
1·026	44 15	1 066	43 10	1·107	6	1·149	2	1·193	58	1·239	54	1·288	37 50
1·027	14	1·067	9	1·107	42 5	1·150	1	1·194	57	1·240	53	1·288	49
1·028	13	1·067	8	1·108	4	1·150	41 0	1·195	56	1·241	52	1·289	48
1·028	12	1·068	7	1·109	3	1·151	40 59	1·195	39 55	1·241	51	1·290	47
1·029	11	1·069	6	1·109	2	1·152	58	1·196	54	1·242	38 50	1·291	46
1·029	44 10	1·069	43 5	1·110	1	1·152	57	1·197	53	1·243	49	1·291	37 45
1·030	9	1·070	4	1·111	42 0	1·153	56	1·197	52	1·244	48	1·292	44
1·031	8	1·070	3	1·111	41 59	1·154	40 55	1·198	51	1·244	47	1·293	43
1·031	7	1·071	2	1·112	58	1·154	54	1·199	39 50	1·245	46	1·294	42
1·032	6	1·072	1	1·113	57	1·155	53	1·199	49	1·246	38 45	1·295	41
1·032	44 5	1·072	43 0	1·113	56	1·156	52	1·200	48	1·247	44	1·295	37 40
1·033	4	1·073	42 59	1·114	41 55	1·156	51	1·201	47	1·247	43	1·296	39
1·034	3	1·074	58	1·114	54	1·157	40 50	1·202	46	1·248	42	1·297	38
1·034	2	1·074	57	1·115	53	1·158	49	1·202	39 45	1·249	41	1·298	37
1·035	1	1·075	56	1·116	52	1·158	48	1·203	44	1·250	38 40	1·298	36
1·035	44 0	1·075	42 55	1·116	51	1·159	47	1·204	43	1·250	39	1·299	37 35
1·036	43 59	1·076	54	1·117	41 50	1·160	46	1·204	42	1·251	38	1·300	34
1·037	58	1·077	53	1·118	49	1·161	40 45	1·205	41	1·252	37	1·301	33
1·037	57	1·077	52	1·118	48	1·161	44	1·206	39 40	1·253	36	1·302	32
1·038	56	1·078	51	1·119	47	1·162	43	1·207	39	1·253	38 35	1·302	31

Table C[1].

AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
1·303	37 30	1·355	36 25	1·410	35 21	1·467	34 17	1·527	33 13	1·591	32 9	1·659	31 5
1·304	29	1·356	24	1·411	35 20	1·468	16	1·528	16	1·592	8	1·660	4
1·305	28	1·357	23	1·411	19	1·469	34 15	1·529	11	1·593	7	1·661	3
1·306	27	1·358	22	1·412	18	1·470	14	1·530	33 10	1·594	6	1·662	2
1·306	26	1·359	21	1·413	17	1·470	13	1·531	9	1·595	32 5	1·663	1
1·307	37 25	1·360	36 20	1·414	16	1·471	12	1·532	8	1·596	4	1·664	31 0
1·308	24	1·360	19	1·415	35 15	1·472	11	1·533	7	1·597	3	1·665	30 59
1·309	23	1·361	18	1·416	14	1·473	34 10	1·534	6	1·598	2	1·666	58
1·309	22	1·362	17	1·417	13	1·474	9	1·535	33 5	1·599	1	1·668	57
1·310	21	1·363	16	1·418	12	1·475	8	1·536	4	1·600	32 0	1·669	56
1·311	37 20	1·364	36 15	1·418	11	1·476	7	1·537	3	1·601	31 59	1·670	30 55
1·312	19	1·365	14	1·419	35 10	1·477	6	1·538	2	1·602	58	1·671	54
1·313	18	1·365	13	1·420	9	1·478	34 5	1·539	1	1·603	57	1·672	53
1·313	17	1·366	12	1·421	8	1·479	4	1·540	33 0	1·604	56	1·673	52
1·314	16	1·367	11	1·422	7	1·480	3	1·541	32 59	1·605	31 55	1·674	51
1·315	37 15	1·368	36 10	1·423	6	1·481	2	1·542	58	1·607	54	1·675	30 50
1·316	14	1·369	9	1·424	35 5	1·482	1	1·543	57	1·608	53	1·676	49
1·317	13	1·370	8	1·425	4	1·483	34 0	1·544	56	1·609	52	1·677	48
1·317	12	1·370	7	1·425	3	1·483	33 59	1·545	32 55	1·610	51	1·679	47
1·318	11	1·371	6	1·426	2	1·484	58	1·546	54	1·611	31 50	1·680	46
1·319	37 10	1·372	36 5	1·427	1	1·485	57	1·547	53	1·612	49	1·681	30 45
1·320	9	1·373	4	1·428	35 0	1·486	56	1·548	52	1·613	48	1·682	44
1·321	8	1·374	3	1·429	34 59	1·487	33 55	1·549	51	1·614	47	1·683	43
1·321	7	1·375	2	1·430	58	1·488	54	1·550	32 50	1·615	46	1·684	42
1·322	6	1·375	1	1·431	57	1·489	53	1·551	49	1·616	31 45	1·685	41
1·323	37 5	1·376	36 0	1·432	56	1·490	52	1·552	48	1·617	44	1·686	30 40
1·324	4	1·377	35 59	1·433	34 55	1·491	51	1·553	47	1·618	43	1·687	39
1·325	3	1·378	58	1·433	54	1·492	33 50	1·554	46	1·619	42	1·689	38
1·325	2	1·379	57	1·434	53	1·493	49	1·555	32 45	1·620	41	1·690	37
1·326	1	1·380	56	1·435	52	1·494	48	1·556	44	1·621	31 40	1·691	36
1·327	37 0	1·381	35 55	1·436	51	1·495	47	1·557	43	1·622	39	1·692	30 35
1·328	36 59	1·381	54	1·437	34 50	1·496	46	1·558	42	1·623	38	1·693	34
1·329	58	1·382	53	1·438	49	1·497	33 45	1·559	41	1·624	37	1·694	33
1·329	57	1·383	52	1·439	48	1·498	44	1·560	32 40	1·625	36	1·695	32
1·330	56	1·384	51	1·440	47	1·498	43	1·561	39	1·626	31 35	1·696	31
1·331	36 55	1·385	35 50	1·441	46	1·499	42	1·562	38	1·628	34	1·698	30 30
1·332	54	1·386	49	1·441	34 45	1·500	41	1·563	37	1·629	33	1·699	29
1·333	53	1·386	48	1·442	44	1·501	33 40	1·564	36	1·630	32	1·700	28
1·333	52	1·387	47	1·443	43	1·502	39	1·565	32 35	1·631	31	1·701	27
1·334	51	1·388	46	1·444	42	1·503	38	1·566	34	1·632	31 30	1·702	26
1·335	36 50	1·389	35 45	1·445	41	1·504	37	1·567	33	1·633	29	1·703	30 25
1·336	49	1·390	44	1·446	34 40	1·505	36	1·568	32	1·634	28	1·704	24
1·337	48	1·391	43	1·447	39	1·506	33 35	1·569	31	1·635	27	1·706	23
1·337	47	1·392	42	1·448	38	1·507	34	1·570	32 30	1·636	26	1·707	22
1·338	46	1·392	41	1·449	37	1·508	33	1·571	29	1·637	31 25	1·708	21
1·339	36 45	1·393	35 40	1·450	36	1·509	32	1·572	28	1·638	24	1·709	30 20
1·340	44	1·394	39	1·450	34 35	1·510	31	1·573	27	1·639	23	1·710	19
1·341	43	1·395	38	1·451	34	1·511	33 30	1·574	26	1·640	22	1·711	18
1·342	42	1·396	37	1·452	33	1·512	29	1·575	32 25	1·641	21	1·712	17
1·342	41	1·397	36	1·453	32	1·513	28	1·576	24	1·643	31 20	1·714	16
1·343	36 40	1·398	35 35	1·454	31	1·514	27	1·577	23	1·644	19	1·715	30 15
1·344	39	1·398	34	1·455	34 30	1·515	26	1·578	22	1·645	18	1·716	14
1·345	38	1·399	33	1·456	29	1·516	33 25	1·579	21	1·646	17	1·717	13
1·346	37	1·400	32	1·457	28	1·517	24	1·580	32 20	1·647	16	1·718	12
1·346	36	1·401	31	1·458	27	1·517	23	1·581	19	1·648	31 15	1·719	11
1·347	36 35	1·402	35 30	1·459	26	1·518	22	1·582	18	1·649	14	1·720	30 10
1·348	34	1·403	29	1·460	34 25	1·519	21	1·583	17	1·650	13	1·722	9
1·349	33	1·404	28	1·460	24	1·520	33 20	1·584	16	1·651	12	1·723	8
1·350	32	1·404	27	1·461	23	1·521	19	1·585	32 15	1·652	11	1·724	7
1·351	31	1·405	26	1·462	22	1·522	18	1·586	14	1·653	31 10	1·725	6
1·351	36 30	1·406	35 25	1·463	21	1·523	17	1·587	13	1·654	9	1·726	30 5
1·352	29	1·407	24	1·464	34 20	1·524	16	1·588	12	1·655	8	1·727	4
1·353	28	1·408	23	1·465	19	1·525	33 15	1·589	11	1·657	7	1·729	3
1·354	27	1·409	22	1·466	18	1·526	14	1·590	32 10	1·658	6	1·730	2
1·355	26	1·410	21	1·467	17	1·527	13	1·591	9	1·659	31 5	1·731	1

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AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
1·732	30 0	1·810	28 55	1·893	27 51	1·981	26 47	2·076	25 43	2·179	24 39	2·291	23 35
1·733	29 59	1·811	54	1·894	27 50	1·982	46	2·078	42	2·181	38	2·293	34
1·734	58	1·813	53	1·895	49	1·984	26 45	2·079	41	2·182	37	2·294	33
1·736	57	1·814	52	1·897	48	1·985	44	2·081	25 40	2·184	36	2·296	32
1·737	56	1·815	51	1·898	47	1·987	43	2·082	39	2·186	24 35	2·298	31
1·738	29 55	1·816	28 50	1·899	46	1·988	42	2·084	38	2·188	34	2·300	23 30
1·739	54	1·818	49	1·901	27 45	1·990	41	2·086	37	2·189	33	2·302	29
1·740	53	1·819	48	1·902	44	1·991	26 40	2 087	36	2·191	32	2·303	28
1·741	52	1·820	47	1·903	43	1·993	39	2·089	25 35	2·193	31	2·305	27
1·743	51	1·821	46	1·905	42	1·994	38	2·090	34	2·194	24 30	2·307	26
1·744	29 50	1·823	28 45	1·906	41	1·995	37	2·092	33	2·196	29	2·309	23 25
1·745	49	1·824	44	1·907	27 40	1·997	36	2·093	32	2·198	28	2·311	24
1·746	48	1·825	43	1·909	39	1·998	26 35	2·095	31	2·199	27	2·313	23
1·747	47	1·826	42	1·910	38	2·000	34	2·096	25 30	2·201	26	2·315	22
1·748	46	1·828	41	1·911	37	2·001	33	2·098	29	2·203	24 25	2·316	21
1·750	29 45	1·829	28 40	1·913	36	2·003	32	2·100	28	2·204	24	2·318	23 20
1·751	44	1·830	39	1·914	27 35	2·004	31	2·101	27	2·206	23	2·320	19
1·752	43	1·832	38	1·915	34	2·006	26 30	2·103	26	2·208	22	2·322	18
1·753	42	1·833	37	1·917	33	2·007	29	2·104	25 25	2·210	21	2·324	17
1·754	41	1·834	36	1·918	32	2·009	28	2·106	24	2·211	24 20	2·326	16
1·756	29 40	1·835	28 35	1·920	31	2·010	27	2·108	23	2·213	19	2·328	23 15
1·757	39	1·837	34	1·921	27 30	2·011	26	2·109	22	2·215	18	2·329	14
1·758	38	1·838	33	1·922	29	2·013	26 25	2·111	21	2·216	17	2·331	13
1·759	37	1·839	32	1·924	28	2·014	24	2·112	25 20	2·218	16	2·333	12
1·760	36	1·840	31	1·925	27	2·016	23	2·114	19	2·220	24 15	2·335	11
1·761	29 35	1·842	28 30	1·926	26	2·017	22	2·115	18	2·222	14	2·337	23 10
1·763	34	1·843	29	1·928	27 25	2·019	21	2·117	17	2·223	13	2·339	9
1·764	33	1·844	28	1·929	24	2·020	26 20	2·119	16	2·225	12	2·341	8
1·765	32	1·846	27	1·931	23	2·022	19	2·120	25 15	2·227	11	2·343	7
1·766	31	1·847	26	1·932	22	2·023	18	2·122	14	2·229	24 10	2·344	6
1·767	29 30	1·848	28 25	1·933	21	2·025	17	2·123	13	2·230	9	2·346	23 5
1·769	29	1·849	24	1·935	27 20	2·026	16	2·125	12	2·232	8	2·348	4
1·770	28	1·851	23	1·936	19	2·028	26 15	2·127	11	2·234	7	2·350	3
1·771	27	1·852	22	1·937	18	2·029	14	2·128	25 10	2·235	6	2·352	2
1·772	26	1·853	21	1·939	17	2·031	13	2·130	9	2·237	24 5	2·354	1
1·773	29 25	1·855	28 20	1·940	16	2·032	12	2·131	8	2·239	4	2·356	23 0
1·775	24	1·856	19	1·942	27 15	2·034	11	2·133	7	2·241	3	2·358	22 59
1·776	23	1·857	18	1·943	14	2·035	26 10	2·135	6	2·242	2	2·360	58
1·777	22	1·858	17	1·944	13	2·037	9	2·136	25 5	2·244	1	2·362	57
1·778	21	1·860	16	1·946	12	2·038	8	2·138	4	2·246	24 0	2·363	56
1·780	29 20	1·861	28 15	1·947	11	2·040	7	2·140	3	2·248	23 59	2·365	22 55
1·781	19	1·862	14	1·949	27 10	2·041	6	2·141	2	2·250	58	2·367	54
1·782	18	1·864	13	1·950	9	2·043	26 5	2·143	1	2·251	57	2·369	53
1·783	17	1·865	12	1·951	8	2·044	4	2·144	25 0	2·253	56	2·371	52
1·784	16	1·866	11	1·953	7	2·046	3	2·146	24 59	2·255	23 55	2·373	51
1·786	29 15	1·868	28 10	1·954	6	2·047	2	2·148	58	2·257	54	2·375	22 50
1·787	14	1·869	9	1·956	27 5	2·049	1	2·149	57	2·258	53	2·377	49
1·788	13	1·870	8	1·957	4	2·050	26 0	2·151	56	2·260	52	2·379	48
1·789	12	1·871	7	1·958	3	2·052	25 59	2·153	24 55	2·262	51	2·381	47
1·790	11	1·873	6	1·960	2	2·053	58	2·154	54	2·264	23 50	2·383	46
1·792	29 10	1·874	28 5	1·961	1	2·055	57	2·156	53	2·265	49	2·385	22 45
1·793	9	1·875	4	1·963	27 0	2·056	56	2·158	52	2·267	48	2·387	44
1·794	8	1·877	3	1·964	26 59	2·058	25 55	2·159	51	2·269	47	2·389	43
1·795	7	1·878	2	1·965	58	2·059	54	2·161	24 50	2·271	46	2·391	42
1·797	6	1·879	1	1·967	57	2·061	53	2·163	49	2·273	23 45	2·392	41
1·798	29 5	1·881	28 0	1·968	56	2·062	52	2·164	48	2·274	44	2·394	22 40
1·799	4	1·882	27 59	1·970	26 55	2·064	51	2·166	47	2·276	43	2·396	39
1·800	3	1·883	58	1·971	54	2·065	25 50	2·167	46	2·278	42	2·398	38
1·802	2	1·885	57	1·972	53	2·067	49	2·169	24 45	2·280	41	2·400	37
1·803	1	1·886	56	1·974	52	2·069	48	2·171	44	2·282	23 40	2·402	36
1·804	29 0	1·887	27 55	1·975	51	2·070	47	2·172	43	2·283	39	2·404	22 35
1·805	28 59	1·889	54	1·977	26 50	2·072	46	2·174	42	2·285	38	2·406	34
1·806	58	1·890	53	1·978	49	2·073	25 45	2·176	41	2·287	37	2·408	33
1·808	57	1·891	52	1·980	48	2·075	44	2·177	24 40	2·290	36	2·410	32
1·809	56	1·893	51	1·981	47	2·076	43	2·179	39	2·291	23 35	2·412	31

Table C[1].

AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
2·414	22 30	2·549	21 25	2·696	20 21	2·858	19 17	3·038	18 13	3·240	17 9	3·468	16 5
2·416	29	2·552	24	2·699	20 20	2·861	16	3·041	12	3·244	8	3·472	4
2·418	28	2·554	23	2·701	19	2·864	19 15	3·044	11	3·247	7	3·476	3
2·420	27	2·556	22	2·703	18	2·866	14	3·047	18 10	3·251	6	3·480	2
2·422	26	2·558	21	2·706	17	2·869	13	3·050	9	3·254	17 5	3·484	1
2·424	22 25	2·560	21 20	2·708	16	2·872	12	3·053	8	3·257	4	3·487	16 0
2·426	24	2·563	19	2·711	20 15	2·874	11	3·056	7	3·261	3	3·491	15 59
2·428	23	2·565	18	2·713	14	2·877	19 10	3·059	6	3·264	2	3·495	58
2·430	22	2·567	17	2·715	13	2·880	9	3·062	18 5	3·267	1	3·499	57
2·432	21	2·569	16	2·718	12	2·882	8	3·066	4	3·271	17 0	3·503	56
2·434	22 20	2·571	21 15	2·720	11	2·885	7	3·069	3	3·274	16 59	3·507	15 55
2·436	19	2·574	14	2·723	20 10	2·888	6	3·072	2	3·278	58	3·510	54
2·438	18	2·576	13	2·725	9	2·891	19 5	3·075	1	3·281	57	3·514	53
2·440	17	2·578	12	2·728	8	2·893	4	3·078	18 0	3·284	56	3·518	52
2·442	16	2·580	11	2·730	7	2·896	3	3·081	17 59	3·288	16 55	3·522	51
2·444	22 15	2·583	21 10	2·733	6	2·899	2	3·084	58	3·291	54	3·526	15 50
2·446	14	2·585	9	2·735	20 5	2·901	1	3·087	57	3·295	53	3·530	49
2·448	13	2·587	8	2·737	4	2·904	19 0	3·090	56	3·298	52	3·534	48
2·450	12	2·589	7	2·740	3	2·907	18 59	3·093	17 55	3·302	51	3·538	47
2·452	11	2·592	6	2·742	2	2·910	58	3·096	54	3·305	16 50	3·542	46
2·454	22 10	2·594	21 5	2·745	1	2·912	57	3·099	53	3·309	49	3·546	15 45
2·457	9	2·596	4	2·747	20 0	2·915	56	3·102	52	3·312	48	3·550	44
2·459	8	2·598	3	2·750	19 59	2·918	18 55	3·105	51	3·316	47	3·554	43
2·461	7	2·601	2	2·752	58	2·921	54	3·108	17 50	3·319	46	3·558	42
2·463	6	2·603	1	2·755	57	2·923	53	3·111	49	3·323	16 45	3·562	41
2·465	22 5	2·605	21 0	2·757	56	2·926	52	3·115	48	3·326	44	3·566	15 40
2·467	4	2·607	20 59	2·760	19 55	2·929	51	3·118	47	3·330	43	3·570	39
2·469	3	2·610	58	2·762	54	2·932	18 50	3·121	46	3·333	42	3·574	38
2·471	2	2·612	57	2·765	53	2·935	49	3·124	17 45	3·337	41	3·578	37
2·473	1	2·614	56	2·767	52	2·937	48	3·127	44	3·340	16 40	3·582	36
2·475	22 0	2·616	20 55	2·770	51	2·940	47	3·130	43	3·344	39	3·586	15 35
2·477	21 59	2·619	54	2·773	19 50	2·943	46	3·133	42	3·347	38	3·590	34
2·479	58	2·621	53	2·775	49	2·946	18 45	3·136	41	3·351	37	3·594	33
2·481	57	2·623	52	2·778	48	2·949	44	3·140	17 40	3·354	36	3·598	32
2·483	56	2·626	51	2·780	47	2·951	43	3·143	39	3·358	16 35	3·602	31
2·485	21 55	2·628	20 50	2·783	46	2·954	42	3·146	38	3·362	34	3·606	15 30
2·488	54	2·630	49	2·785	19 45	2·957	41	3·149	37	3·365	33	3·610	29
2·490	53	2·632	48	2·788	44	2·960	18 40	3·152	36	3·369	32	3·614	28
2·492	52	2·635	47	2·790	43	2·963	39	3·156	17 35	3·372	31	3·618	27
2·494	51	2·637	46	2·793	42	2·966	38	3·159	34	3·376	16 30	3·622	26
2·496	21 50	2·639	20 45	2·795	41	2·969	37	3·162	33	3·379	29	3·626	15 25
2·498	49	2·642	44	2·798	19 40	2·971	36	3·165	32	3·383	28	3·630	24
2·500	48	2·644	43	2·801	39	2·974	18 35	3·168	31	3·387	27	3·635	23
2·502	47	2·646	42	2·803	38	2·977	34	3·172	17 30	3·390	26	3·639	22
2·504	46	2·649	41	2·806	37	2·980	33	3·175	29	3·394	16 25	3·643	21
2·507	21 45	2·651	20 40	2·808	36	2·983	32	3·178	28	3·398	24	3·647	15 20
2·509	44	2·653	39	2·811	19 35	2·986	31	3·181	27	3·401	23	3·651	19
2·511	43	2·656	38	2·813	34	2·989	18 30	3·184	26	3·405	22	3·655	18
2·513	42	2·658	37	2·816	33	2·992	29	3·188	17 25	3·409	21	3·660	17
2·515	41	2·660	36	2·819	32	2·994	28	3·191	24	3·412	16 20	3·664	16
2·517	21 40	2·663	20 35	2·821	31	2·997	27	3·194	23	3·416	19	3·668	15 15
2·519	39	2·665	34	2·824	19 30	3·000	26	3·197	22	3·420	18	3·672	14
2·521	38	2·667	33	2·826	29	3·003	18 25	3·201	21	3·423	17	3·676	13
2·523	37	2·670	32	2·829	28	3·006	24	3·204	17 20	3·427	16	3·681	12
2·526	36	2·672	31	2·832	27	3·009	23	3·207	19	3·431	16 15	3·685	11
2·528	21 35	2·675	20 30	2·834	26	3·012	22	3·211	18	3·434	14	3·689	15 10
2·530	34	2·677	29	2·837	19 25	3·015	21	3·214	17	3·438	13	3·693	9
2·532	33	2·679	28	2·840	24	3·018	18 20	3·217	16	3·442	12	3·698	8
2·534	32	2·682	27	2·842	23	3·021	19	3·220	17 15	3·446	11	3·702	7
2·536	31	2·684	26	2·845	22	3·024	18	3·224	14	3·450	16 10	3·706	6
2·539	21 30	2·686	20 25	2·848	21	3·027	17	3·227	13	3·453	9	3·710	15 5
2·541	29	2·689	24	2·850	19 20	3·030	16	3·230	12	3·457	8	3·715	4
2·543	28	2·691	23	2·853	19	3·033	18 15	3·234	11	3·461	7	3·719	3
2·545	27	2·694	22	2·856	18	3·036	14	3·237	17 10	3·465	6	3·723	2
2·547	26	2·696	21	2·858	17	3·038	13	3·240	9	3·468	16 5	3·728	1

Table C[1].

AZIMUTH CORRESPONDING TO A AND B CORRECTION IN DEPARTURE.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
3·732	15 0	4·036	13 55	4·384	12 51	4·794	11 47	5·284	10 43	5·881	9 39	6·625	8 35
3·736	14 59	4·041	54	4·390	12 50	4·861	46	5·292	42	5·891	38	6·638	34
3·741	58	4·046	53	4·396	49	4·808	11 45	5·301	41	5·902	37	6·651	33
3·745	57	4·051	52	4·401	48	4·815	44	5·309	10 40	5·912	36	6·665	32
3·749	56	4·056	51	4·407	47	4·822	43	5·318	39	5·923	9 35	6·678	31
3·754	14 55	4·061	13 50	4·413	46	4·829	42	5·326	38	5·933	34	6·691	8 30
3·758	54	4·066	49	4·419	12 45	4·836	41	5·335	37	5·944	33	6·704	29
3·763	53	4·071	48	4·425	44	4·843	11 40	5·343	36	5·954	32	6·718	28
3·767	52	4·076	47	4·431	43	4·850	39	5·352	10 35	5·965	31	6·731	27
3·771	51	4·081	46	4·437	42	4·857	38	5·361	34	5·976	9 30	6·745	26
3·776	14 50	4·087	13 45	4·443	41	4·864	37	5·369	33	5·986	29	6·758	8 25
3·780	49	4·092	44	4·449	12 40	4·871	36	5·378	32	5·997	28	6·772	24
3·785	48	4·097	43	4·455	12 39	4·879	11 35	5·387	31	6·008	27	6·786	23
3·789	47	4·102	42	4·461	38	4·886	34	5·395	10 30	6·019	26	6·799	22
3·794	46	4·107	41	4·468	37	4·893	33	5·404	29	6·030	9 25	6·813	21
3·798	14 45	4·113	13 40	4·474	36	4·901	32	5·413	28	6·040	24	6·827	8 20
3·803	44	4·118	39	4·480	12 35	4·908	31	5·422	27	6·051	23	6·841	19
3·807	43	4·123	38	4·486	34	4·915	11 30	5·431	26	6·062	22	6·855	18
3·812	42	4·128	37	4·492	33	4·922	29	5·440	10 25	6·073	21	6·869	17
3·816	41	4·133	36	4·498	32	4·930	28	5·449	24	6·084	9 20	6·883	16
3·821	14 40	4·139	13 35	4·504	31	4·937	27	5·457	23	6·095	19	6·897	8 15
3·825	39	4·144	34	4·511	12 30	4·945	26	5·466	22	6·107	18	6·911	14
3·830	38	4·149	33	4·517	29	4·952	11 25	5·475	21	6·118	17	6·925	13
3·834	37	4·155	32	4·523	28	4·959	24	5·484	10 20	6·129	16	6·939	12
3·839	36	4·160	31	4·529	27	4·967	23	5·494	19	6·140	9 15	6·954	11
3·844	14 35	4·165	13 30	4·536	26	4·974	22	5·503	18	6·151	14	6·968	8 10
3·848	34	4·171	29	4·542	12 25	4·982	21	5·512	17	6·163	13	6·983	9
3·853	33	4·176	28	4·548	24	4·989	11 20	5·521	16	6·174	12	6·997	8
3·857	32	4·181	27	4·554	23	4·997	19	5·530	10 15	6·186	11	7·012	7
3·862	31	4·187	26	4·561	22	5·005	18	5·539	14	6·197	9 10	7·026	6
3·867	14 30	4·192	13 25	4·567	21	5·012	17	5·548	13	6·208	9	7·041	8 5
3·871	29	4·197	24	4·574	12 20	5·020	16	5·558	12	6·220	8	7·056	4
3·876	28	4·203	23	4·580	19	5·027	11 15	5·567	11	6·232	7	7·071	3
3·881	27	4·208	22	4·586	18	5·035	14	5·576	10 10	6·243	6	7·085	2
3·885	26	4·214	21	4·593	17	5·043	13	5·586	9	6·255	9 5	7·100	1
3·890	14 25	4·219	13 20	4·599	16	5·050	12	5·595	8	6·267	4	7·115	8 0
3·895	24	4·225	19	4·606	12 15	5·058	11	5·604	7	6·278	3	7·130	7 59
3·899	23	4·230	18	4·612	14	5·066	11 10	5·614	6	6·290	2	7·146	58
3·904	22	4·236	17	4·619	13	5·074	9	5·623	10 5	6·302	1	7·161	57
3·909	21	4·241	16	4·625	12	5·081	8	5·633	4	6·314	9 0	7·176	56
3·914	14 20	4·247	13 15	4·632	11	5·089	7	5·642	3	6·326	8 59	7·191	7 55
3·918	19	4·252	14	4·638	12 10	5·097	6	5·652	2	6·338	58	7·207	54
3·923	18	4·258	13	4·645	9	5·105	11 5	5·662	1	6·350	57	7·222	53
3·928	17	4·263	12	4·651	8	5·113	4	5·671	10 0	6·362	56	7·237	52
3·933	16	4·269	11	4·658	7	5·121	3	5·681	9 59	6·374	8 55	7·253	51
3·937	14 15	4·275	13 10	4·665	6	5·129	2	5·691	58	6·386	54	7·269	7 50
3·942	14	4·280	9	4·671	12 5	5·136	1	5·700	57	6·398	53	7·284	49
3·947	13	4·286	8	4·678	4	5·145	11 0	5·710	56	6·410	52	7·300	48
3·952	12	4·292	7	4·685	3	5·153	10 59	5·720	9 55	6·422	51	7·316	47
3·957	11	4·297	6	4·691	2	5·161	58	5·730	54	6·435	8 50	7·332	46
3·962	14 10	4·303	13 5	4·698	1	5·169	57	5·740	53	6·447	49	7·348	7 45
3·967	9	4·309	4	4·705	12 0	5·177	56	5·749	52	6·460	48	7·364	44
3·971	8	4·314	3	4·711	11 59	5·185	10 55	5·759	51	6·472	47	7·380	43
3·976	7	4·320	2	4·718	58	5·193	54	5·769	9 50	6·485	46	7·396	42
3·981	6	4·326	1	4·725	57	5·201	53	5·779	49	6·497	8 45	7·412	41
3·986	14 5	4·331	13 0	4·732	56	5·209	52	5·789	48	6·510	44	7·429	7 40
3·991	4	4·337	12 59	4·738	11 55	5·217	51	5·799	47	6·522	43	7·445	39
3·996	3	4·343	58	4·745	54	5·226	10 50	5·809	46	6·535	42	7·461	38
4·001	2	4·349	57	4·752	53	5·234	49	5·820	9 45	6·548	41	7·478	37
4·006	1	4·355	56	4·759	52	5·242	48	5·830	44	6·561	8 40	7·495	36
4·011	14 0	4·360	12 55	4·766	51	5·250	47	5·840	43	6·573	39	7·511	7 35
4·016	13 59	4·366	54	4·773	11 50	5·259	46	5·850	42	6·586	38	7·528	34
4·021	58	4·372	53	4·780	49	5·267	10 45	5·860	41	6·599	37	7·545	33
4·026	57	4·378	52	4·787	48	5·275	44	5·871	9 40	6·612	36	7·562	32
4·031	56	4·384	51	4·794	47	5·284	43	5·881	39	6·625	8 35	7·579	31

Table C[1].

Azimuth Corresponding to A and B Correction in Departure.

A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.	A & B	Az.
′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′
7·60	7 30	8·89	6 25	10·71	5 20	13·4	4 16	17·9	3 12	26·8	2 8	53·7	1 4
7·61	29	8·92	24	10·75	19	13·5	4 15	18·0	11	27·1	7	54·6	3
7·63	28	8·94	23	10·78	18	13·5	14	18·1	3 10	27·3	6	55·4	2
7·65	27	8·96	22	10·81	17	13·6	13	18·2	9	27·5	2 5	56·4	1
7·66	26	8·99	21	10·85	16	13·6	12	18·3	8	27·7	4	57·3	1 0
7·68	7 25	9·01	6 20	10·88	5 15	13·7	11	18·4	7	27·9	3	58·3	0 59
7·70	24	9·03	19	10·92	14	13·7	4 10	18·5	6	28·2	2	59·3	58
7·72	23	9·06	18	10·95	13	13·8	9	18·6	3 5	28·4	1	60·3	57
7·73	22	9·08	17	10·99	12	13·8	8	18·7	4	28·6	2 0	61·4	56
7·75	21	9·11	16	11·02	11	13·9	7	18·8	3	28·9	1 59	62·5	0 55
7·77	7 20	9·13	6 15	11·06	5 10	14·0	6	18·9	2	29·1	58	63·7	54
7·79	19	9·16	14	11·10	9	14·0	4 5	19·0	1	29·4	57	64·9	53
7·81	18	9·18	13	11·13	8	14·1	4	19·1	3 0	29·6	56	66·1	52
7·82	17	9·21	12	11·17	7	14·1	3	19·2	2 59	29·9	1 55	67·4	51
7·84	16	9·23	11	11·20	6	14·2	2	19·3	58	30·1	54	68·7	0 50
7·86	7 15	9·26	6 10	11·24	5 5	14·2	1	19·4	57	30·4	53	70·2	49
7·88	14	9·28	9	11·28	4	14·3	4 0	19·5	56	30·7	52	71·6	48
7·90	13	9·31	8	11·32	3	14·4	3 59	19·6	2 55	31·0	51	73·1	47
7·92	12	9·33	7	11·35	2	14·4	58	19·7	54	31·2	1 50	74·7	46
7·93	11	9·36	6	11·39	1	14·5	57	19·9	53	31·5	49	76·4	0 45
7·95	7 10	9·38	6 5	11·43	5 0	14·5	56	20·0	52	31·8	48	78·1	44
7·97	9	9·41	4	11·47	4 59	14·6	3 55	20·1	51	32·1	47	79·9	43
7·99	8	9·44	3	11·51	58	14·7	54	20·2	2 50	32·4	46	81·8	42
8·01	7	9·46	2	11·55	57	14·7	53	20·3	49	32·7	1 45	83·8	41
8·03	6	9·49	1	11·59	56	14·8	52	20·4	48	33·0	44	85·9	0 40
8·05	7 5	9·51	6 0	11·62	4 55	14·9	51	20·6	47	33·4	43	88·1	39
8·07	4	9·54	5 59	11·67	54	14·9	3 50	20·7	46	33·7	42	90·5	38
8·09	3	9·57	58	11·71	53	15·0	49	20·8	2 45	34·0	41	92·9	37
8·10	2	9·59	57	11·74	52	15·1	48	20·9	44	34·4	1 40	95·5	36
8·12	1	9·62	56	11·78	51	15·1	47	21·1	43	34·7	39	98·2	0 35
8·14	7 0	9·65	5 55	11·83	4 50	15·2	46	21·2	42	35·1	38	101	34
8·16	6 59	9·68	54	11·87	49	15·3	3 45	21·3	41	35·4	37	104	33
8·18	58	9·70	53	11·91	48	15·3	44	21·5	2 40	35·8	36	107	32
8·20	57	9·73	52	11·95	47	15·4	43	21·6	39	36·2	1 35	111	31
8·22	56	9·76	51	11·99	46	15·5	42	21·7	38	36·6	34	115	0 30
8·24	6 55	9·79	5 50	12·03	4 45	15·5	41	21·9	37	37·0	33	118	29
8·26	54	9·82	49	12·08	44	15·6	3 40	22·0	36	37·4	32	123	28
8·28	53	9·84	48	12·12	43	15·7	39	22·2	2 35	37·8	31	127	27
8·30	52	9·87	47	12·16	42	15·7	38	22·3	34	38·2	1 30	132	26
8·32	51	9·90	46	12·21	41	15·8	37	22·5	33	38·6	29	138	0 25
8·34	6 50	9·93	5 45	12·25	4 40	15·9	36	22·6	32	39·0	28	143	24
8·36	49	9·96	44	12·29	39	16·0	3 35	22·8	31	39·5	27	149	23
8·39	48	9·99	43	12·34	38	16·0	34	22·9	2 30	40·0	26	156	22
8·41	47	10·02	42	12·38	37	16·1	33	23·1	29	40·4	1 25	164	21
8·43	46	10·05	41	12·43	36	16·2	32	23·2	28	40·9	24	172	0 20
8·45	6 45	10·08	5 40	12·47	4 35	16·3	31	23·4	27	41·4	23	181	19
8·47	44	10·11	39	12·52	34	16·3	3 30	23·5	26	41·9	22	191	18
8·49	43	10·13	38	12·57	33	16·4	29	23·7	2 25	42·4	21	202	17
8·51	42	10·17	37	12·61	32	16·5	28	23·9	24	43·0	1 20	215	16
8·53	41	10·20	36	12·66	31	16·6	27	24·0	23	43·5	19	229	0 15
8·56	6 40	10·23	5 35	12·71	4 30	16·7	26	24·2	22	44·1	18	246	14
8·58	39	10·26	34	12·75	29	16·7	3 25	24·4	21	44·6	17	264	13
8·60	38	10·29	33	12·80	28	16·8	24	24·5	2 20	45·2	16	286	12
8·62	37	10·32	32	12·85	27	16·9	23	24·7	19	45·8	1 15	313	11
8·64	36	10·35	31	12·90	26	17·0	22	24·9	18	46·4	14	344	0 10
8·66	6 35	10·39	5 30	12·95	4 25	17·1	21	25·1	17	47·1	13	382	9
8·69	34	10·42	29	13·00	24	17·2	3 20	25·2	16	47·7	12	430	8
8·71	33	10·45	28	13·05	23	17·3	19	25·5	2 15	48·4	11	491	7
8·73	32	10·48	27	13·10	22	17·3	18	25·6	14	49·1	1 10	573	6
8·75	31	10·51	26	13·15	21	17·4	17	25·8	13	49·8	9	688	0 5
8·78	6 30	10·55	5 25	13·20	4 20	17·5	16	26·0	12	50·5	8	859	4
8·80	29	10·58	24	13·25	19	17·6	3 15	26·2	11	51·3	7	1146	3
8·82	28	10·61	23	13·30	18	17·7	14	26·4	2 10	52·1	6	1719	2
8·85	27	10·65	22	13·35	17	17·8	13	26·6	9	52·9	1 5	3438	1
8·87	26	10·68	21	13·40	16	17·9	12	26·8	8	53·7	4	Infinite	0 0

Table C[2].

POSITION-LINES CORRESPONDING TO THE A AND B CORRECTION, FOR USE WITH THE PLANE-SCALE CHART IN THE SUMNER PROBLEM.

Name the position-line according to the name of the A and B correction, and contrary to the name of the bearing of the body observed.

A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.	A and B Correction.	Position-lines.
′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°
·00	0·0	·25	14·0	·50	26·6	·75	36·9	1·00	45·0	1·42	54·8	1·92	62·5	4·2	76·6
·01	0·6	·26	14·6	·51	27·0	·76	37·2	1·01	45·3	1·44	55·2	1·94	62·7	4·4	77·2
·02	1·1	·27	15·1	·52	27·5	·77	37·6	1·02	45·6	1·46	55·6	1·96	63·0	4·6	77·7
·03	1·7	·28	15·6	·53	27·9	·78	38·0	1·03	45·8	1·48	56·0	1·98	63·2	4·8	78·2
·04	2·3	·29	16·2	·54	28·4	·79	38·3	1·04	46·1	1·50	56·3	2·00	63·4	5·0	78·7
·05	2·9	·30	16·7	·55	28·8	·80	38·7	1·05	46·4	1·52	56·7	2·05	64·0	5·5	79·7
·06	3·4	·31	17·2	·56	29·2	·81	39·0	1·06	46·7	1·54	57·0	2·10	64·5	6·0	80·5
·07	4·0	·32	17·7	·57	29·7	·82	39·4	1·07	46·9	1·56	57·3	2·15	65·1	6·5	81·3
·08	4·6	·33	18·3	·58	30·1	·83	39·7	1·08	47·2	1·58	57·7	2·20	65·6	7·0	81·9
·09	5·1	·34	18·8	·59	30·5	·84	40·0	1·10	47·7	1·60	58·0	2·25	66·0	8·0	82·9
·10	5·7	·35	19 3	·60	31·0	·85	40·4	1·12	48·2	1·62	58·3	2·30	66·5	9·0	83·7
·11	6 3	·36	19·8	·61	31·4	·86	40·7	1·14	48·7	1·64	58·6	2·40	67·4	10·0	84·3
·12	6·8	·37	20·3	·62	31·8	·87	41·0	1·16	49·2	1·66	58·9	2·50	68·2	11·0	84·8
·13	7·4	·38	20·8	·63	32·2	·88	41·3	1·18	49·7	1·68	59·2	2·60	69·0	12·0	85·2
·14	8·0	·39	21·3	·64	32·6	·89	41·7	1·20	50·2	1·70	59·5	2·70	69·7	13·0	85·6
·15	8·5	·40	21·8	·65	33·0	·90	42·0	1·22	50·7	1·72	59·8	2·80	70·3	15·0	86·2
·16	9·1	·41	22·3	·66	33·4	·91	42·3	1·24	51·1	1·74	60·1	2·90	71·0	17·0	86·6
·17	9·6	·42	22·8	·67	33 8	·92	42·6	1·26	51·6	1·76	60·4	3·00	71·6	20·0	87·1
·18	10·2	·43	23·3	68	34·2	·93	42·9	1·28	52·0	1·78	60·7	3·10	72·1	25·0	87·7
·19	10·8	·44	23 7	·69	34·6	·94	43·2	1·30	52·4	1·80	60·9	3·20	72·6	30·0	88·1
·20	11·3	45	24·2	·70	35·0	·95	43·5	1·32	52·9	1·82	61·2	3·30	73·1	40·0	88·6
·21	11·9	·46	24·7	·71	35·4	96	43·8	1·34	53·3	1·84	61·5	3·40	73·6	50·0	88·9
·22	12·4	·47	25·2	72	35·8	·97	44·1	1·36	53·7	1·86	61·7	3·60	74·5	100·0	89·4
·23	13·0	·48	25·6	·73	36·1	·98	44·4	1·38	54·1	1·88	62·0	3·80	75·3	200·0	89·7
·24	13 5	·49	26·1	·74	36·5	·99	44·7	1·40	54·5	1·90	62·2	4·00	76·0	Infinite	90·0

It must be borne in mind that this table does not give the *true* geographical lines of position, but lines of position which will give the same result as to latitude and longitude on a plane chart as the true lines of position would give on a Mercator's chart. It is given here for the purpose of saving the trouble of getting out a chart. All that is required for plotting the Sumner position will be a horizontal line in the work-book representing the D.R. latitude, and a perpendicular line to the former for use in laying off the position-lines by a protractor. On the horizontal line set off the points of two longitudes at a distance from one another of, say, 1 in. to 10′ of longitude. From these two points lay down the Sumner lines, and from the point where they intersect draw a perpendicular to the line of D.R. latitudes. The longitude at the point struck by the perpendicular is the longitude required, and can be measured from either of the points of longitude. The same scale is used for the latitude as for the longitude.

A small 5 in. boxwood protractor rule with a diagonal scale of inches for measuring to $\frac{1}{100}$ part of an inch may be bought for 1s., and is the only instrument which will be required.

To find the *true* position-line from this table consider the A and B correction as a diff. long., the dep. corresponding to this diff. long. will then give the true line of position, and will give the same position—*i.e.*, latitude and longitude—on the Mercator chart that the other lines of position give on the plane chart.

Example for true position-line: In lat 47° S. a.m. sun's obsn., when A and B cor. = d. long. ·85′ N. dep = ·58′ N. = true position-line N. 30·1° W.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.														
	90°	89°	88°	87°	86°	85°	84°	83°	82°	81°	80°	79°	78°	77°	76°
°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
0	4·00	4·00	4·00	4·01	4·01	4·02	4·02	4·03	4·04	4·05	4·06	4·07	4·09	4·10	4·12
1	4·00	4·00	4·00	4·01	4·01	4·02	4·02	4·03	4·04	4·05	4·06	4·08	4·09	4·11	4·12
2	4·00	4·00	4·00	4·01	4·01	4·02	4·02	4·03	4·04	4·05	4·06	4·08	4·09	4·11	4·12
3	4·01	4·01	4·01	4·01	4·02	4·02	4·03	4·04	4·04	4·06	4·07	4·08	4·09	4·11	4·13
4	4·01	4·01	4·01	4·02	4·02	4·03	4·03	4·04	4·05	4·06	4·07	4·08	4·10	4·12	4·13
5	4·01	4·02	4·02	4·02	4·03	4·03	4·04	4·05	4·05	4 07	4·08	4·09	4·10	4·12	4 14
6	4·02	4·02	4·02	4·03	4·03	4·04	4·04	4·05	4·06	4·07	4·08	4·10	4·11	4·13	4·15
7	4·03	4·03	4·03	4·04	4·04	4·05	4·05	4·06	4·07	4·08	4·09	4·11	4·12	4·14	4·15
8	4·04	4·04	4·04	4·04	4·05	4·05	4·06	4·07	4·08	4·09	4·10	4·11	4·13	4·15	4·16
9	4·05	4·05	4·05	4·06	4·06	4·07	4·07	4·08	4·09	4·10	4·11	4·13	4·14	4·16	4·17
10	4·06	4·06	4·06	4·07	4·07	4·08	4·08	4·09	4·10	4·11	4·12	4·14	4·15	4·17	4·19
11	4·07	4·08	4·08	4·08	4·08	4·09	4·10	4·11	4·11	4·13	4·14	4·15	4·17	4·18	4·20
12	4·09	4·09	4·09	4·09	4·10	4·10	4·11	4·12	4·13	4·14	4·15	4·17	4·18	4·20	4·21
13	4·10	4·11	4·11	4·11	4·12	4·12	4·13	4·14	4·15	4·16	4·17	4·18	4·20	4·21	4·23
14	4·12	4·12	4·12	4·13	4·13	4·14	4·15	4·15	4·16	4·17	4·19	4·20	4·21	4·23	4·25
15	4·14	4·14	4·14	4·15	4·15	4·16	4·16	4·17	4·18	4·19	4·20	4·22	4·23	4·25	4·27
16	4·16	4·16	4·16	4·17	4·17	4·18	4·18	4·19	4·20	4·21	4·23	4·24	4·25	4·27	4·29
17	4·18	4·18	4·19	4·19	4·19	4·20	4·21	4·21	4·22	4·23	4·25	4·26	4·28	4·29	4·31
18	4·21	4·21	4·21	4·21	4·22	4·22	4·23	4·24	4·25	4·26	4·27	4·28	4·30	4·32	4·33
19	4·23	4·23	4·23	4·24	4·24	4·25	4·25	4·26	4·27	4·28	4·30	4·31	4·32	4·34	4·36
20	4·26	4·26	4·26	4·26	4·27	4·27	4·28	4·29	4·30	4·31	4·32	4·34	4·35	4·37	4·39
21	4·28	4·29	4·29	4·29	4·30	4·30	4·31	4·32	4·33	4·34	4·35	4·36	4·38	4·40	4·42
22	4·31	4·31	4·32	4·32	4·32	4·33	4·34	4·35	4·36	4·37	4·38	4·39	4·41	4·43	4·45
23	4·34	4·35	4·35	4·35	4·36	4·36	4·37	4·38	4·39	4·40	4·41	4·43	4·44	4·46	4·48
24	4·38	4·38	4·38	4·38	4·39	4·40	4·40	4·41	4·42	4·43	4·45	4·46	4·48	4·49	4·51
25	4·41	4·41	4·42	4·42	4·42	4·43	4·44	4·45	4·46	4·47	4·48	4·50	4·51	4·53	4·55
26	4·45	4·45	4·45	4·46	4·46	4·47	4·47	4·48	4·49	4·51	4·52	4·53	4·55	4·57	4·59
27	4·49	4·49	4·49	4·49	4·50	4·51	4·51	4·52	4·53	4·55	4·56	4·57	4·59	4·61	4·63
28	4·53	4·53	4·53	4·54	4·54	4·55	4·55	4·56	4·57	4·59	4·60	4·62	4·63	4·65	4·67
29	4·57	4·57	4·58	4·58	4·58	4·59	4·60	4·61	4·62	4·63	4·64	4·66	4·68	4·69	4·71
30	4·62	4·62	4·62	4·63	4·63	4·64	4·64	4·65	4·66	4·68	4·69	4·71	4·72	4·74	4·76
31	4·67	4·67	4·67	4·67	4·68	4·68	4·69	4·70	4·71	4·72	4·74	4·75	4·77	4·79	4·81
32	4·72	4·72	4·72	4·72	4·73	4·73	4·74	4·75	4·76	4·78	4·79	4·80	4·82	4·84	4·86
33	4·77	4·77	4·77	4·78	4·78	4·79	4·80	4·81	4·82	4·83	4·84	4·86	4·88	4·89	4·92
34	4·82	4·82	4·83	4·83	4·84	4·84	4·85	4·86	4·87	4·89	4·90	4·92	4·93	4·95	4·97
35	4·88	4·88	4·89	4·89	4·90	4·90	4·91	4·92	4·93	4·94	4·96	4·97	4·99	5·01	5·03
36	4·94	4·95	4·95	4·95	4·96	4·96	4·97	4·98	4·99	5·01	5·02	5·04	5·05	5·07	5·10
37	5·01	5·01	5·01	5·02	5·02	5·03	5·04	5·05	5·06	5·07	5·09	5·10	5·12	5·14	5·16
38	5·08	5·08	5·08	5·08	5·09	5·10	5·10	5·11	5·13	5·14	5·15	5·17	5·19	5·21	5·23
39	5·15	5·15	5·15	5·15	5·16	5·17	5·18	5·18	5·20	5·21	5·23	5·24	5·26	5·28	5·30
40	5·22	5·22	5·22	5·23	5·23	5·24	5·25	5·26	5·27	5·29	5·30	5·32	5·34	5·36	5·38
41	5·30	5·30	5·30	5·31	5·31	5·32	5·33	5·34	5·35	5·37	5·38	5·40	5·42	5·44	5·46
42	5·38	5·38	5·39	5·39	5·40	5·40	5·41	5·42	5·44	5·45	5·47	5·48	5·50	5·52	5·55
43	5·47	5·47	5·47	5·48	5·48	5·49	5·50	5·51	5·52	5·54	5·55	5·57	5·59	5·61	5·64
44	5·56	5·56	5·56	5·57	5·57	5·58	5·59	5·60	5·62	5·63	5·65	5·66	5·68	5·71	5·73
45	5·66	5·66	5·66	5·66	5·67	5·68	5·69	5·70	5·71	5·73	5·74	5·76	5·78	5·81	5·83
46	5·76	5·76	5·76	5·77	5·77	5·78	5·79	5·80	5·81	5·83	5·85	5·87	5·89	5·91	5·93
47	5·87	5·87	5·87	5·87	5·88	5·89	5·90	5·91	5·92	5·94	5·96	5·97	6·00	6·02	6·04
48	5·98	5·98	5·98	5·99	5·99	6·00	6·01	6·02	6·04	6·05	6·07	6·09	6·11	6·14	6·16
49	6·10	6·10	6·10	6·11	6·11	6·12	6·13	6·14	6·16	6 17	6·19	6·21	6·23	6·26	6·28
50	6·22	6·22	6·23	6·23	6·24	6·25	6·26	6·27	6·28	6·30	6·32	6·34	6·36	6·39	6·41
51	6·36	6·36	6·36	6·36	6·37	6·38	6·39	6·40	6·42	6·44	6·45	6·48	6·50	6·52	6·55
52	6·50	6·50	6·50	6·51	6·51	6·52	6·53	6·55	6·56	6·58	6·60	6·62	6·64	6·67	6·70
53	6·65	6·65	6·65	6·66	6·66	6·67	6·68	6·70	6·71	6·73	6·75	6·77	6·80	6·82	6·85
54	6·81	6·81	6·81	6·81	6·82	6·83	6·84	6·86	6·87	6·89	6·91	6·93	6·96	6·98	7·01
55	6·97	6·97	6·98	6·98	6·99	7·00	7·01	7·03	7·04	7·06	7·08	7·10	7·13	7·16	7·19
56	7·15	7·15	7·16	7·16	7·17	7·18	7·19	7·21	7·22	7·24	7·26	7·29	7·31	7·34	7·37
57	7·34	7·35	7·35	7·35	7·36	7·37	7·38	7·40	7·42	7·44	7·46	7·48	7·51	7·54	7·57
58	7·55	7·55	7·55	7·56	7·57	7·58	7·59	7·61	7·62	7·64	7·66	7·69	7·72	7·75	7·78
59	7·77	7·77	7·77	7·78	7·79	7·80	7·81	7·82	7·84	7·86	7·89	7·91	7·94	7·97	8·00
60	8·00	8·00	8·00	8·01	8·02	8·03	8·04	8·06	8·08	8·10	8·12	8·15	8·18	8·21	8·24

To convert time into longitude divide by 4. Thus 8·00 s. ÷ 4 = 2′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.														
	75°	74°	73°	72°	71°	70°	69°	68°	67°	66°	65°	64°	63°	62°	61°
°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
0	4·14	4·16	4·18	4·21	4·23	4·26	4·28	4·31	4·35	4·38	4·41	4·45	4·49	4·53	4·57
1	4·14	4·16	4·18	4·21	4·23	4·26	4·29	4·31	4·35	4·38	4·41	4·45	4·49	4·53	4·57
2	4·14	4·16	4·19	4·21	4·23	4·26	4·29	4·32	4·35	4·38	4·42	4·45	4·49	4·53	4·58
3	4·15	4·17	4·19	4·21	4·24	4·26	4·29	4·32	4·35	4·38	4·42	4·46	4·50	4·54	4·58
4	4·15	4·17	4·19	4·22	4·24	4·27	4·30	4·32	4·36	4·39	4·42	4·46	4·50	4·54	4·58
5	4·16	4·18	4·20	4·22	4·25	4·27	4·30	4·33	4·36	4·40	4·43	4·47	4·51	4·55	4·59
6	4·16	4·18	4·21	4·23	4·25	4·28	4·31	4·34	4·37	4·40	4·44	4·47	4·51	4·56	4·60
7	4·17	4·19	4·21	4·24	4·26	4·29	4·32	4·35	4·38	4·41	4·45	4·48	4·52	4·56	4·61
8	4·18	4·20	4·22	4·25	4·27	4·30	4·33	4·36	4·39	4·42	4·46	4·49	4·53	4·57	4·62
9	4·19	4·21	4·23	4·26	4·28	4·31	4·34	4·37	4·40	4·43	4·47	4·51	4·55	4·59	4·63
10	4·20	4·23	4·25	4·27	4·30	4·32	4·35	4·38	4·41	4·45	4·48	4·52	4·56	4·60	4·64
11	4·22	4·24	4·26	4·28	4·31	4·34	4·36	4·39	4·43	4·46	4·50	4·53	4·57	4·62	4·66
12	4·23	4·25	4·28	4·30	4·32	4·35	4·38	4·41	4·44	4·48	4·51	4·55	4·59	4·63	4·68
13	4·25	4·27	4·29	4·32	4·34	4·37	4·40	4·43	4·46	4·49	4·53	4·57	4·61	4·65	4·69
14	4·27	4·29	4·31	4·33	4·36	4·39	4·42	4·45	4·48	4·51	4·55	4·59	4·63	4·67	4·71
15	4·29	4·31	4·33	4·35	4·38	4·41	4·44	4·47	4·50	4·53	4·57	4·61	4·65	4·69	4·73
16	4·31	4·33	4·35	4·38	4·40	4·43	4·46	4·49	4·52	4·56	4·59	4·63	4·67	4·71	4·76
17	4·33	4·35	4·37	4·40	4·42	4·45	4·48	4·51	4·54	4·58	4·62	4·65	4·69	4·74	4·78
18	4·35	4·38	4·40	4·42	4·45	4·48	4·51	4·54	4·57	4·60	4·64	4·68	4·72	4·76	4·81
19	4·38	4·40	4·42	4·45	4·47	4·50	4·53	4·56	4·60	4·63	4·67	4·71	4·75	4·79	4·84
20	4·41	4·43	4·45	4·48	4·50	4·53	4·56	4·59	4·62	4·66	4·70	4·74	4·78	4·82	4·87
21	4·44	4·46	4·48	4·51	4·53	4·56	4·59	4·62	4·65	4·69	4·73	4·77	4·81	4·85	4·90
22	4·47	4·49	4·51	4·54	4·56	4·59	4·62	4·65	4·69	4·72	4·76	4·80	4·84	4·89	4·93
23	4·50	4·52	4·54	4·57	4·60	4·62	4·65	4·69	4·72	4·76	4·79	4·83	4·88	4·92	4·97
24	4·53	4·56	4·58	4·60	4·63	4·66	4·69	4·72	4·76	4·79	4·83	4·87	4·91	4·96	5·01
25	4·57	4·59	4·62	4·64	4·67	4·70	4·73	4·76	4·79	4·83	4·87	4·91	4·95	5·00	5·05
26	4·61	4·63	4·65	4·68	4·71	4·74	4·77	4·80	4·83	4·87	4·91	4·95	4·99	5·04	5·09
27	4·65	4·67	4·69	4·72	4·75	4·78	4·81	4·84	4·88	4·91	4·95	5·00	5·04	5·08	5·13
28	4·69	4·71	4·74	4·76	4·79	4·82	4·85	4·89	4·92	4·96	5·00	5·04	5·08	5·13	5·18
29	4·73	4·76	4·78	4·81	4·84	4·87	4·90	4·93	4·97	5·01	5·05	5·09	5·13	5·18	5·23
30	4·78	4·80	4·83	4·86	4·88	4·92	4·95	4·98	5·02	5·06	5·10	5·14	5·18	5·23	5·28
31	4·83	4·85	4·88	4·91	4·94	4·97	5·00	5·03	5·07	5·11	5·15	5·19	5·24	5·29	5·34
32	4·88	4·91	4·93	4·96	4·99	5·02	5·05	5·09	5·12	5·16	5·20	5·25	5·29	5·34	5·39
33	4·94	4·96	4·99	5·01	5·04	5·08	5·11	5·14	5·18	5·22	5·26	5·31	5·35	5·40	5·45
34	5·00	5·02	5·05	5·07	5·10	5·13	5·17	5·20	5·24	5·28	5·32	5·37	5·42	5·46	5·52
35	5·06	5·08	5·11	5·13	5·16	5·20	5·23	5·27	5·30	5·35	5·39	5·43	5·48	5·53	5·58
36	5·12	5·14	5·17	5·20	5·23	5·26	5·30	5·33	5·37	5·41	5·46	5·50	5·55	5·60	5·65
37	5·19	5·21	5·24	5·27	5·30	5·33	5·36	5·40	5·44	5·48	5·53	5·57	5·62	5·67	5·73
38	5·26	5·28	5·31	5·34	5·37	5·40	5·44	5·47	5·51	5·56	5·60	5·65	5·70	5·75	5·80
39	5·33	5·35	5·38	5·41	5·44	5·48	5·51	5·55	5·59	5·63	5·68	5·73	5·78	5·83	5·88
40	5·41	5·43	5·46	5·49	5·52	5·56	5·59	5·63	5·67	5·72	5·76	5·81	5·86	5·91	5·97
41	5·49	5·51	5·54	5·57	5·61	5·64	5·68	5·72	5·76	5·80	5·85	5·90	5·95	6·00	6·06
42	5·57	5·60	5·63	5·66	5·69	5·73	5·77	5·81	5·85	5·89	5·94	5·99	6·04	6·10	6·15
43	5·66	5·69	5·72	5·75	5·78	5·82	5·86	5·90	5·94	5·99	6·03	6·09	6·14	6·19	6·25
44	5·76	5·78	5·81	5·85	5·88	5·92	5·96	6·00	6·04	6·09	6·14	6·19	6·24	6·30	6·36
45	5·86	5·88	5·92	5·95	5·98	6·02	6·06	6·10	6·15	6·19	6·24	6·29	6·35	6·41	6·47
46	5·97	5·99	6·02	6·05	6·09	6·13	6·17	6·21	6·26	6·30	6·35	6·41	6·46	6·52	6·58
47	6·07	6·10	6·13	6·17	6·20	6·24	6·28	6·33	6·37	6·42	6·47	6·53	6·58	6·64	6·71
48	6·19	6·22	6·25	6·29	6·32	6·36	6·40	6·45	6·49	6·54	6·60	6·65	6·71	6·77	6·83
49	6·31	6·34	6·38	6·41	6·45	6·49	6·53	6·58	6·62	6·67	6·73	6·78	6·84	6·91	6·97
50	6·44	6·47	6·51	6·54	6·58	6·62	6·67	6·71	6·76	6·81	6·87	6·92	6·98	7·05	7·11
51	6·58	6·61	6·65	6·68	6·72	6·76	6·81	6·86	6·90	6·96	7·01	7·07	7·13	7·20	7·27
52	6·73	6·76	6·79	6·83	6·87	6·91	6·96	7·01	7·06	7·11	7·17	7·23	7·29	7·36	7·43
53	6·88	6·91	6·95	6·99	7·03	7·07	7·12	7·17	7·22	7·28	7·33	7·39	7·46	7·53	7·60
54	7·05	7·08	7·12	7·16	7·20	7·24	7·29	7·34	7·39	7·45	7·51	7·57	7·64	7·71	7·78
55	7·22	7·25	7·29	7·33	7·38	7·42	7·47	7·52	7·58	7·63	7·69	7·76	7·83	7·90	7·97
56	7·41	7·44	7·48	7·52	7·57	7·61	7·66	7·71	7·77	7·83	7·89	7·96	8·03	8·10	8·18
57	7·60	7·64	7·68	7·72	7·77	7·82	7·87	7·92	7·98	8·04	8·10	8·17	8·24	8·32	8·40
58	7·81	7·85	7·89	7·94	7·98	8·03	8·09	8·14	8·20	8·26	8·33	8·40	8·47	8·55	8·63
59	8·04	8·08	8·12	8·17	8·21	8·26	8·32	8·38	8·44	8·50	8·57	8·64	8·72	8·80	8·88
60	8·28	8·32	8·37	8·41	8·46	8·51	8·57	8·63	8·69	8·76	8·83	8·90	8·98	9·06	9·15

To convert time into longitude divide by 4. Thus 8·28 s. ÷ 4 = 2·07′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.														
	60°	59°	58°	57°	56°	55°	54°	53°	52°	51°	50°	49°	48°	47°	46°
°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
0	4·62	4·67	4·72	4·77	4·82	4·88	4·94	5·01	5·08	5·15	5·22	5·30	5·38	5·47	5·56
1	4·62	4·67	4·72	4·77	4·83	4·88	4·95	5·01	5·08	5·15	5·22	5·30	5·38	5·47	5·56
2	4·62	4·67	4·72	4·77	4·83	4·89	4·95	5·01	5·08	5·15	5·22	5·30	5·39	5·47	5·56
3	4·63	4·67	4·72	4·78	4·83	4·89	4·95	5·02	5·08	5·15	5·23	5·31	5·39	5·48	5·57
4	4·63	4·68	4·73	4·78	4·84	4·90	4·96	5·02	5·09	5·16	5·23	5·31	5·40	5·48	5·57
5	4·64	4·68	4·73	4·79	4·84	4·90	4·96	5·03	5·10	5·17	5·24	5·32	5·40	5·49	5·58
6	4·64	4·69	4·74	4·80	4·85	4·91	4·97	5·04	5·10	5·17	5·25	5·33	5·41	5·50	5·59
7	4·65	4·70	4·75	4·81	4·86	4·92	4·98	5·05	5·11	5·19	5·26	5·34	5·42	5·51	5·60
8	4·66	4·71	4·76	4·82	4·87	4·93	4·99	5·06	5·13	5·20	5·27	5·35	5·44	5·52	5·62
9	4·68	4·72	4·78	4·83	4·89	4·94	5·01	5·07	5·14	5·21	5·29	5·37	5·45	5·54	5·63
10	4·69	4·74	4·79	4·84	4·90	4·96	5·02	5·09	5·15	5·23	5·30	5·38	5·47	5·55	5·65
11	4·71	4·75	4·81	4·86	4·92	4·97	5·04	5·10	5·17	5·24	5·32	5·40	5·48	5·57	5·66
12	4·72	4·77	4·82	4·88	4·93	4·99	5·05	5·12	5·19	5·26	5·34	5·42	5·50	5·59	5·68
13	4·74	4·79	4·84	4·89	4·95	5·01	5·07	5·14	5·21	5·28	5·36	5·44	5·52	5·61	5·71
14	4·76	4·81	4·86	4·92	4·97	5·03	5·10	5·16	5·23	5·30	5·38	5·46	5·55	5·64	5·73
15	4·78	4·83	4·88	4·94	5·00	5·06	5·12	5·19	5·26	5·33	5·41	5·49	5·57	5·66	5·76
16	4·80	4·85	4·91	4·96	5·02	5·08	5·14	5·21	5·28	5·35	5·43	5·51	5·60	5·69	5·78
17	4·83	4·88	4·93	4·99	5·05	5·11	5·17	5·24	5·31	5·38	5·46	5·54	5·63	5·72	5·81
18	4·86	4·91	4·96	5·01	5·07	5·13	5·20	5·27	5·34	5·41	5·49	5·57	5·66	5·75	5·85
19	4·88	4·94	4·99	5·04	5·10	5·16	5·23	5·30	5·37	5·44	5·52	5·60	5·69	5·78	5·88
20	4·92	4·97	5·02	5·08	5·13	5·20	5·26	5·33	5·40	5·48	5·56	5·64	5·73	5·82	5·92
21	4·95	5·00	5·05	5·11	5·17	5·23	5·30	5·36	5·44	5·51	5·59	5·68	5·77	5·86	5·96
22	4·98	5·03	5·09	5·14	5·20	5·27	5·33	5·40	5·47	5·55	5·63	5·72	5·81	5·90	6·00
23	5·02	5·07	5·12	5·18	5·24	5·30	5·37	5·44	5·51	5·59	5·67	5·76	5·85	5·94	6·04
24	5·06	5·11	5·16	5·22	5·28	5·34	5·41	5·48	5·56	5·63	5·72	5·80	5·89	5·99	6·09
25	5·10	5·15	5·20	5·26	5·32	5·39	5·46	5·53	5·60	5·68	5·76	5·85	5·94	6·03	6·13
26	5·14	5·19	5·25	5·31	5·37	5·43	5·50	5·57	5·65	5·73	5·81	5·90	5·99	6·09	6·19
27	5·18	5·24	5·29	5·35	5·42	5·48	5·55	5·62	5·70	5·78	5·86	5·95	6·04	6·14	6·24
28	5·23	5·28	5·34	5·40	5·46	5·53	5·60	5·67	5·75	5·83	5·91	6·00	6·10	6·19	6·30
29	5·28	5·34	5·39	5·45	5·52	5·58	5·65	5·73	5·80	5·88	5·97	6·06	6·15	6·25	6·36
30	5·33	5·39	5·45	5·51	5·57	5·64	5·71	5·78	5·86	5·94	6·03	6·12	6·22	6·32	6·42
31	5·39	5·44	5·50	5·56	5·63	5·70	5·77	5·84	5·92	6·00	6·09	6·18	6·28	6·38	6·49
32	5·45	5·50	5·56	5·62	5·69	5·76	5·83	5·91	5·99	6·07	6·16	6·25	6·35	6·45	6·56
33	5·51	5·56	5·62	5·69	5·75	5·82	5·90	5·97	6·05	6·14	6·23	6·32	6·42	6·52	6·63
34	5·57	5·63	5·69	5·75	5·82	5·89	5·96	6·04	6·12	6·21	6·30	6·39	6·49	6·60	6·71
35	5·64	5·70	5·76	5·82	5·89	5·96	6·04	6·11	6·20	6·28	6·37	6·47	6·57	6·68	6·79
36	5·71	5·77	5·83	5·90	5·96	6·04	6·11	6·19	6·27	6·36	6·45	6·55	6·65	6·76	6·87
37	5·78	5·84	5·91	5·97	6·04	6·11	6·19	6·27	6·36	6·44	6·54	6·64	6·74	6·85	6·96
38	5·86	5·92	5·99	6·05	6·12	6·20	6·27	6·36	6·44	6·53	6·63	6·73	6·83	6·94	7·06
39	5·94	6·00	6·07	6·14	6·21	6·28	6·36	6·44	6·53	6·62	6·72	6·82	6·93	7·04	7·16
40	6·03	6·09	6·16	6·23	6·30	6·37	6·45	6·54	6·63	6·72	6·82	6·92	7·03	7·14	7·26
41	6·12	6·18	6·25	6·32	6·39	6·47	6·55	6·64	6·73	6·82	6·92	7·02	7·13	7·25	7·37
42	6·22	6·28	6·35	6·42	6·49	6·57	6·65	6·74	6·83	6·93	7·03	7·13	7·24	7·36	7·48
43	6·32	6·38	6·45	6·52	6·60	6·68	6·76	6·85	6·94	7·04	7·14	7·25	7·36	7·48	7·60
44	6·42	6·49	6·56	6·63	6·71	6·79	6·87	6·96	7·06	7·16	7·26	7·37	7·48	7·60	7·73
45	6·53	6·60	6·67	6·75	6·82	6·91	6·99	7·08	7·18	7·28	7·38	7·50	7·61	7·73	7·86
46	6·65	6·72	6·79	6·87	6·95	7·03	7·12	7·21	7·31	7·41	7·52	7·63	7·75	7·87	8·00
47	6·77	6·84	6·92	6·99	7·07	7·16	7·25	7·34	7·44	7·55	7·66	7·77	7·89	8·02	8·15
48	6·90	6·97	7·05	7·13	7·21	7·30	7·39	7·49	7·59	7·69	7·80	7·92	8·04	8·17	8·31
49	7·04	7·11	7·19	7·27	7·35	7·44	7·54	7·63	7·74	7·85	7·96	8·08	8·20	8·34	8·48
50	7·19	7·26	7·34	7·42	7·51	7·60	7·69	7·79	7·90	8·01	8·12	8·25	8·37	8·51	8·65
51	7·34	7·42	7·49	7·58	7·67	7·76	7·86	7·96	8·07	8·18	8·30	8·42	8·55	8·69	8·84
52	7·50	7·58	7·66	7·75	7·84	7·93	8·03	8·14	8·24	8·36	8·48	8·61	8·74	8·88	9·03
53	7·67	7·75	7·84	7·93	8·02	8·11	8·22	8·32	8·43	8·55	8·68	8·81	8·94	9·09	9·24
54	7·86	7·94	8·02	8·11	8·21	8·31	8·41	8·52	8·64	8·76	8·88	9·02	9·16	9·30	9·46
55	8·05	8·14	8·22	8·32	8·41	8·51	8·62	8·73	8·85	8·97	9·10	9·24	9·38	9·54	9·69
56	8·26	8·35	8·43	8·53	8·63	8·73	8·84	8·96	9·08	9·20	9·34	9·48	9·63	9·78	9·94
57	8·48	8·57	8·66	8·76	8·86	8·97	9·08	9·20	9·32	9·45	9·59	9·73	9·88	10·04	10·21
58	8·72	8·81	8·90	9·00	9·10	9·21	9·33	9·45	9·58	9·71	9·85	10·00	10·16	10·32	10·49
59	8·97	9·06	9·16	9·26	9·37	9·48	9·60	9·72	9·86	9·99	10·14	10·29	10·45	10·62	10·80
60	9·24	9·33	9·43	9·54	9·65	9·77	9·89	10·02	10·15	10·29	10·44	10·60	10·77	10·94	11·12

To convert time into longitude divide by 4. Thus 9·24 s. ÷ 4 = 2·31′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.														
	45°	44°	43°	42°	41°	40°	39°	38°	37°	36°	35°	34°	33°	32°	31°
°	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.
0	5·66	5·76	5·87	5·98	6·10	6·22	6·36	6·50	6·65	6·81	6·97	7·15	7·34	7·55	7·77
1	5·66	5·76	5·87	5·98	6·10	6·22	6·36	6·50	6·65	6·81	6·97	7·15	7·35	7·55	7·77
2	5·66	5·76	5·87	5·98	6·10	6·23	6·36	6·50	6·65	6·81	6·98	7·16	7·35	7·55	7·77
3	5·66	5·77	5·87	5·99	6·11	6·23	6·36	6·51	6·66	6·81	6·98	7·16	7·35	7·56	7·78
4	5·67	5·77	5·88	5·99	6·11	6·24	6·37	6·51	6·66	6·82	6·99	7·17	7·36	7·57	7·79
5	5·68	5·78	5·89	6·00	6·12	6·25	6·38	6·52	6·67	6·83	7·00	7·18	7·37	7·58	7·80
6	5·69	5·79	5·90	6·01	6·13	6·26	6·39	6·53	6·68	6·84	7·01	7·19	7·38	7·59	7·81
7	5·70	5·80	5·91	6·02	6·14	6·27	6·40	6·55	6·70	6·86	7·03	7·21	7·40	7·61	7·82
8	5·71	5·81	5·92	6·04	6·16	6·28	6·42	6·56	6·71	6·87	7·04	7·22	7·42	7·62	7·84
9	5·73	5·83	5·94	6·05	6·17	6·30	6·44	6·58	6·73	6·89	7·06	7·24	7·44	7·64	7·86
10	5·74	5·85	5·96	6·07	6·19	6·32	6·45	6·60	6·75	6·91	7·08	7·26	7·46	7·66	7·89
11	5·76	5·87	5·97	6·09	6·21	6·34	6·48	6·62	6·77	6·93	7·10	7·29	7·48	7·69	7·91
12	5·78	5·89	6·00	6·11	6·23	6·36	6·50	6·64	6·80	6·96	7·13	7·31	7·51	7·72	7·94
13	5·81	5·91	6·02	6·14	6·26	6·39	6·52	6·67	6·82	6·98	7·16	7·34	7·54	7·75	7·97
14	5·83	5·93	6·04	6·16	6·28	6·41	6·55	6·70	6·85	7·01	7·19	7·37	7·57	7·78	8·00
15	5·86	5·96	6·07	6·19	6·31	6·44	6·58	6·73	6·88	7·05	7·22	7·41	7·60	7·81	8·04
16	5·88	5·99	6·10	6·22	6·34	6·47	6·61	6·76	6·91	7·08	7·25	7·44	7·64	7·85	8·08
17	5·92	6·02	6·13	6·25	6·38	6·51	6·65	6·79	6·95	7·12	7·29	7·48	7·68	7·89	8·12
18	5·95	6·05	6·17	6·28	6·41	6·54	6·68	6·83	6·99	7·16	7·33	7·52	7·72	7·94	8·17
19	5·98	6·09	6·20	6·32	6·45	6·58	6·72	6·87	7·03	7·20	7·38	7·57	7·77	7·98	8·21
20	6·02	6·13	6·24	6·36	6·49	6·62	6·76	6·91	7·07	7·24	7·42	7·61	7·82	8·03	8·26
21	6·06	6·17	6·28	6·40	6·53	6·67	6·81	6·96	7·12	7·29	7·47	7·66	7·87	8·09	8·32
22	6·10	6·21	6·33	6·45	6·58	6·71	6·86	7·01	7·17	7·34	7·52	7·71	7·92	8·14	8·38
23	6·15	6·26	6·37	6·49	6·62	6·76	6·90	7·06	7·22	7·39	7·58	7·77	7·98	8·20	8·44
24	6·19	6·30	6·42	6·54	6·67	6·81	6·96	7·11	7·28	7·45	7·63	7·83	8·04	8·26	8·50
25	6·24	6·35	6·47	6·60	6·73	6·87	7·01	7·17	7·33	7·51	7·69	7·89	8·10	8·33	8·57
26	6·29	6·41	6·53	6·65	6·78	6·92	7·07	7·23	7·39	7·57	7·76	7·96	8·17	8·40	8·64
27	6·35	6·46	6·58	6·71	6·84	6·98	7·13	7·29	7·46	7·64	7·83	8·03	8·24	8·47	8·72
28	6·41	6·52	6·64	6·77	6·91	7·05	7·20	7·36	7·53	7·71	7·90	8·10	8·32	8·55	8·80
29	6·47	6·58	6·71	6·83	6·97	7·11	7·27	7·43	7·60	7·78	7·97	8·18	8·40	8·63	8·88
30	6·53	6·65	6·77	6·90	7·04	7·19	7·34	7·50	7·67	7·86	8·05	8·26	8·48	8·72	8·97
31	6·60	6·72	6·84	6·97	7·11	7·26	7·42	7·58	7·75	7·94	8·14	8·35	8·57	8·81	9·06
32	6·67	6·79	6·92	7·05	7·19	7·34	7·49	7·66	7·84	8·02	8·22	8·43	8·66	8·90	9·16
33	6·74	6·87	6·99	7·13	7·27	7·42	7·58	7·75	7·93	8·11	8·32	8·53	8·76	9·00	9·26
34	6·82	6·95	7·07	7·21	7·35	7·51	7·67	7·84	8·02	8·21	8·41	8·63	8·86	9·10	9·37
35	6·91	7·03	7·16	7·30	7·44	7·60	7·76	7·93	8·11	8·31	8·51	8·73	8·97	9·21	9·48
36	6·99	7·12	7·25	7·39	7·54	7·69	7·86	8·03	8·22	8·41	8·62	8·84	9·08	9·33	9·60
37	7·08	7·21	7·34	7·49	7·63	7·79	7·96	8·14	8·32	8·52	8·73	8·96	9·20	9·45	9·72
38	7·18	7·31	7·44	7·59	7·74	7·90	8·07	8·24	8·43	8·64	8·85	9·08	9·32	9·58	9·86
39	7·28	7·41	7·55	7·69	7·85	8·01	8·18	8·36	8·55	8·76	8·97	9·20	9·45	9·71	9·99
40	7·38	7·52	7·66	7·80	7·96	8·12	8·30	8·48	8·68	8·88	9·10	9·34	9·59	9·85	10·14
41	7·50	7·63	7·77	7·92	8·08	8·25	8·42	8·61	8·81	9·02	9·24	9·48	9·73	10·00	10·29
42	7·61	7·75	7·89	8·04	8·20	8·37	8·55	8·74	8·94	9·16	9·38	9·63	9·88	10·16	10·45
43	7·73	7·87	8·02	8·17	8·34	8·51	8·69	8·88	9·09	9·30	9·54	9·78	10·04	10·32	10·62
44	7·86	8·00	8·15	8·31	8·48	8·65	8·84	9·03	9·24	9·46	9·69	9·94	10·21	10·49	10·80
45	8·00	8·14	8·29	8·45	8·62	8·80	8·99	9·19	9·40	9·62	9·86	10·12	10·39	10·67	10·98
46	8·14	8·29	8·44	8·61	8·78	8·96	9·15	9·35	9·57	9·80	10·04	10·30	10·57	10·87	11·18
47	8·29	8·44	8·60	8·77	8·94	9·12	9·32	9·53	9·75	9·98	10·23	10·49	10·77	11·07	11·39
48	8·45	8·61	8·77	8·93	9·11	9·30	9·50	9·71	9·93	10·17	10·42	10·69	10·97	11·25	11·61
49	8·62	8·78	8·94	9·11	9·29	9·49	9·69	9·90	10·13	10·37	10·63	10·90	11·19	11·51	11·84
50	8·80	8·96	9·12	9·30	9·49	9·68	9·89	10·11	10·34	10·59	10·85	11·13	11·43	11·74	12·08
51	8·99	9·15	9·32	9·50	9·69	9·89	10·10	10·30	10·56	10·81	11·08	11·37	11·67	11·99	12·34
52	9·19	9·35	9·53	9·71	9·90	10·11	10·32	10·55	10·80	11·05	11·33	11·62	11·93	12·26	12·61
53	9·40	9·57	9·75	9·93	10·13	10·34	10·56	10·80	11·04	11·31	11·59	11·89	12·20	12·54	12·90
54	9·62	9·80	9·98	10·17	10·37	10·59	10·81	11·05	11·31	11·58	11·86	12·17	12·50	12·84	13·21
55	9·86	10·04	10·23	10·42	10·63	10·85	11·08	11·33	11·59	11·86	12·16	12·47	12·80	13·16	13·54
56	10·12	10·30	10·49	10·69	10·90	11·13	11·37	11·62	11·89	12·17	12·47	12·79	13·13	13·50	13·89
57	10·39	10·57	10·77	10·97	11·19	11·43	11·67	11·92	12·20	12·49	12·80	13·13	13·48	13·86	14·26
58	10·67	10·87	11·07	11·28	11·51	11·74	11·99	12·26	12·54	12·84	13·16	13·50	13·86	14·24	14·66
59	10·98	11·18	11·39	11·61	11·84	12·08	12·34	12·61	12·90	13·21	13·54	13·89	14·26	14·66	15·08
60	11·31	11·52	11·73	11·96	12·19	12·45	12·71	12·99	13·29	13·61	13·95	14·31	14·69	15·10	15·53

To convert time into longitude divide by 4. Thus 12·0 s. ÷ 4 = 3′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.														
	30°	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	19°	18°	17°	16°
°	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.
0	8·00	8·25	8·52	8·81	9·12	9·46	9·83	10·2	10·7	11·2	11·7	12·3	13·0	13·7	14·5
1	8·00	8·25	8·52	8·81	9·13	9·47	9·84	10·2	10·7	11·2	11·7	12·3	13·0	13·7	14·5
2	8·00	8·26	8·53	8·82	9·13	9·47	9·84	10·2	10·7	11·2	11·7	12·3	13·0	13·7	14·5
3	8·01	8·26	8·53	8·82	9·14	9·48	9·85	10·3	10·7	11·2	11·7	12·3	13·0	13·7	14·5
4	8·02	8·27	8·54	8·83	9·15	9·49	9·86	10·3	10·7	11·2	11·7	12·3	13·0	13·7	14·5
5	8·03	8·28	8·55	8·84	9·16	9·50	9·87	10·3	10·7	11·2	11·7	12·3	13·0	13·7	14·6
6	8·04	8·30	8·57	8·86	9·17	9·52	9·89	10·3	10·7	11·2	11·8	12·4	13·0	13·8	14·6
7	8·06	8·31	8·58	8·88	9·19	9·54	9·91	10·3	10·8	11·2	11·8	12·4	13·0	13·8	14·6
8	8·08	8·33	8·60	8·90	9·21	9·56	9·93	10·3	10·8	11·3	11·8	12·4	13·1	13·8	14·7
9	8·10	8·35	8·63	8·92	9·24	9·58	9·96	10·4	10·8	11·3	11·8	12·4	13·1	13·9	14·7
10	8·12	8·38	8·65	8·95	9·27	9·61	9·99	10·4	10·8	11·3	11·9	12·5	13·1	13·9	14·7
11	8·15	8·41	8·68	8·98	9·30	9·64	10·0	10·4	10·9	11·4	11·9	12·5	13·2	13·9	14·8
12	8·18	8·43	8·71	9·01	9·33	9·68	10·1	10·5	10·9	11·4	12·0	12·6	13·2	14·0	14·8
13	8·21	8·47	8·74	9·04	9·36	9·71	10·1	10·5	11·0	11·5	12·0	12·6	13·3	14·0	14·9
14	8·24	8·50	8·78	9·08	9·40	9·75	10·1	10·6	11·0	11·5	12·1	12·7	13·3	14·1	15·0
15	8·28	8·54	8·82	9·12	9·45	9·80	10·2	10·6	11·1	11·6	12·1	12·7	13·4	14·2	15·0
16	8·32	8·58	8·86	9·17	9·49	9·85	10·2	10·6	11·1	11·6	12·2	12·8	13·5	14·2	15·1
17	8·37	8·63	8·91	9·21	9·54	9·90	10·3	10·7	11·2	11·7	12·2	12·8	13·5	14·3	15·2
18	8·41	8·68	8·96	9·26	9·59	9·95	10·3	10·8	11·2	11·7	12·3	12·9	13·6	14·4	15·3
19	8·46	8·73	9·01	9·32	9·65	10·0	10·4	10·8	11·3	11·8	12·4	13·0	13·7	14·5	15·3
20	8·51	8·78	9·07	9·38	9·71	10·1	10·5	10·9	11·4	11·9	12·4	13·1	13·8	14·6	15·4
21	8·57	8·84	9·13	9·44	9·77	10·1	10·5	11·0	11·4	12·0	12·5	13·2	13·9	14·7	15·5
22	8·63	8·90	9·19	9·50	9·84	10·2	10·6	11·0	11·5	12·0	12·6	13·3	14·0	14·8	15·7
23	8·69	8·96	9·26	9·57	9·91	10·3	10·7	11·1	11·6	12·1	12·7	13·3	14·1	14·9	15·8
24	8·76	9·03	9·33	9·64	9·99	10·4	10·8	11·2	11·7	12·2	12·8	13·4	14·2	15·0	15·9
25	8·83	9·10	9·40	9·72	10·1	10·4	10·9	11·3	11·8	12·3	12·9	13·6	14·3	15·1	16·0
26	8·90	9·18	9·48	9·80	10·2	10·5	10·9	11·4	11·9	12·4	13·0	13·7	14·4	15·2	16·1
27	8·98	9·26	9·56	9·89	10·2	10·6	11·0	11·5	12·0	12·5	13·1	13·8	14·5	15·3	16·3
28	9·06	9·34	9·65	9·98	10·3	10·7	11·1	11·6	12·1	12·6	13·2	13·9	14·7	15·5	16·4
29	9·15	9·43	9·74	10·1	10·4	10·8	11·2	11·7	12·2	12·8	13·4	14·0	14·8	15·6	16·6
30	9·24	9·53	9·84	10·2	10·5	10·9	11·4	11·8	12·3	12·9	13·5	14·2	14·9	15·8	16·8
31	9·33	9·63	9·94	10·3	10·6	11·0	11·5	11·9	12·5	13·0	13·6	14·3	15·1	16·0	16·9
32	9·43	9·73	10·0	10·4	10·8	11·2	11·6	12·1	12·6	13·2	13·8	14·5	15·3	16·1	17·1
33	9·54	9·84	10·2	10·5	10·9	11·3	11·7	12·2	12·7	13·3	14·0	14·6	15·4	16·3	17·3
34	9·65	9·95	10·3	10·6	11·0	11·4	11·9	12·3	12·9	13·5	14·1	14·8	15·6	16·5	17·5
35	9·77	10·1	10·4	10·8	11·1	11·6	12·0	12·5	13·0	13·6	14·3	15·0	15·8	16·7	17·7
36	9·89	10·2	10·5	10·9	11·3	11·7	12·2	12·7	13·2	13·8	14·5	15·2	16·0	16·9	17·9
37	10·0	10·3	10·7	11·0	11·4	11·9	12·3	12·8	13·4	14·0	14·6	15·4	16·2	17·1	18·2
38	10·2	10·5	10·8	11·2	11·6	12·0	12·5	13·0	13·6	14·2	14·8	15·6	16·4	17·4	18·4
39	10·3	10·6	11·0	11·3	11·7	12·2	12·7	13·2	13·7	14·4	15·0	15·8	16·7	17·6	18·7
40	10·4	10·8	11·1	11·5	11·9	12·4	12·8	13·4	13·9	14·6	15·3	16·0	16·9	17·9	18·9
41	10·6	10·9	11·3	11·7	12·1	12·5	13·0	13·6	14·1	14·8	15·5	16·3	17·2	18·1	19·2
42	10·8	11·1	11·5	11·9	12·3	12·7	13·2	13·8	14·4	15·0	15·7	16·5	17·4	18·4	19·5
43	10·9	11·3	11·6	12·0	12·5	12·9	13·4	14·0	14·6	15·3	16·0	16·8	17·7	18·7	19·8
44	11·1	11·5	11·8	12·2	12·7	13·2	13·7	14·2	14·8	15·5	16·3	17·1	18·0	19·0	20·2
45	11·3	11·7	12·0	12·5	12·9	13·4	13·9	14·5	15·1	15·8	16·5	17·4	18·3	19·3	20·5
46	11·5	11·9	12·3	12·7	13·1	13·6	14·2	14·7	15·4	16·1	16·8	17·7	18·6	19·7	20·9
47	11·7	12·1	12·5	12·9	13·4	13·9	14·4	15·0	15·7	16·4	17·1	18·0	19·0	20·1	21·3
48	12·0	12·3	12·7	13·2	13·6	14·1	14·7	15·3	16·0	16·7	17·5	18·4	19·3	20·4	21·7
49	12·2	12·6	13·0	13·4	13·9	14·4	15·0	15·6	16·3	17·0	17·8	18·7	19·7	20·9	22·1
50	12·4	12·8	13·3	13·7	14·2	14·7	15·3	15·9	16·6	17·4	18·2	19·1	20·1	21·3	22·6
51	12·7	13·1	13·5	14·0	14·5	15·0	15·6	16·3	17·0	17·7	18·6	19·5	20·6	21·7	23·1
52	13·0	13·4	13·8	14·3	14·8	15·4	16·0	16·6	17·3	18·1	19·0	20·0	21·0	22·2	23·6
53	13·3	13·7	14·2	14·6	15·2	15·7	16·3	17·0	17·7	18·5	19·4	20·4	21·5	22·7	24·1
54	13·6	14·0	14·5	15·0	15·5	16·1	16·7	17·4	18·2	19·0	19·9	20·9	22·0	23·3	24·7
55	13·9	14·4	14·9	15·4	15·9	16·5	17·1	17·8	18·6	19·5	20·4	21·4	22·6	23·9	25·3
56	14·3	14·8	15·2	15·8	16·3	16·9	17·6	18·3	19·1	20·0	20·9	22·0	23·1	24·5	26·0
57	14·9	15·1	15·6	16·2	16·8	17·4	18·1	18·8	19·6	20·5	21·5	22·6	23·8	25·1	26·4
58	15·1	15·6	16·1	16·6	17·2	17·9	18·6	19·3	20·1	21·1	22·1	23·2	24·4	25·8	27·4
59	15·5	16·0	16·5	17·1	17·7	18·4	19·1	19·9	20·7	21·7	22·7	23·9	25·1	26·6	28·2
60	16·0	16·5	17·0	17·6	18·2	18·9	19·7	20·5	21·4	22·3	23·4	24·6	25·9	27·4	29·0

To convert time into longitude divide by 4. Thus 16 s. ÷ 4 = 4′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Lat.	AZIMUTHS.															
	15°	14°	13°	12°	11°	10°	9°	8°	7°	6°	5°	4°	3°	2°	1°	
°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	
0	15·4	16·5	17·8	19·2	21·0	23·0	25·6	28·7	32·8	38·3	45·9	57·4	76·4	115	229	
1	15·5	16·5	17·8	19·3	21·0	23·0	25·6	28·7	32·8	38·3	45·9	57·4	76·4	115	229	
2	15·5	16·5	17·8	19·3	21·0	23·0	25·6	28·8	32·8	38·3	45·9	57·4	76·5	115	229	
3	15·5	16·6	17·8	19·3	21·0	23·1	25·6	28·8	32·9	38·3	46·0	57·4	76·5	115	230	
4	15·5	16·6	17·8	19·3	21·0	23·1	25·6	28·8	32·9	38·4	46·0	57·5	76·6	115	230	
5	15·5	16·6	17·8	19·3	21·0	23·1	25·7	28·9	32·9	38·4	46·1	57·6	76·7	115	230	
6	15·5	16·6	17·9	19·3	21·1	23·2	25·7	28·9	33·0	38·5	46·1	57·7	76·9	115	230	
7	15·6	16·7	17·9	19·4	21·1	23·2	25·8	29·0	33·1	38·6	46·2	57·8	77·0	115	231	
8	15·6	16·7	18·0	19·4	21·2	23·3	25·8	29·0	33·1	38·6	46·3	57·9	77·2	116	231	
9	15·6	16·7	18·0	19·5	21·2	23·3	25·9	29·1	33·2	38·7	46·5	58·1	77·4	116	232	
10	15·7	16·8	18·1	19·5	21·3	23·4	26·0	29·2	33·3	38·9	46·6	58·2	77·6	116	233	
11	15·7	16·8	18·1	19·6	21·4	23·5	26·0	29·3	33·4	39·0	46·8	58·4	77·9	117	233	
12	15·8	16·9	18·2	19·7	21·4	23·5	26·1	29·4	33·6	39·1	46·9	58·6	78·1	117	234	
13	15·9	17·0	18·2	19·7	21·5	23·6	26·2	29·5	33·7	39·3	47·1	58·9	78·4	118	235	
14	15·9	17·0	18·3	19·8	21·6	23·7	26·4	29·6	33·8	39·4	47·3	59·1	78·8	118	236	
15	16·0	17·1	18·4	19·9	21·7	23·8	26·5	29·8	34·0	39·6	47·5	59·4	79·1	119	237	
16	16·1	17·2	18·5	20·0	21·8	24·0	26·6	29·9	34·1	39·8	47·7	59·7	79·5	119	238	
17	16·2	17·3	18·6	20·1	21·9	24·1	26·7	30·1	34·3	40·0	48·0	60·0	79·9	120	240	
18	16·2	17·4	18·7	20·2	22·0	24·2	26·9	30·2	34·5	40·2	48·3	60·3	80·4	121	241	
19	16·3	17·5	18·8	20·3	22·2	24·4	27·0	30·4	34·7	40·5	48·5	60·6	80·8	121	242	
20	16·4	17·6	18·9	20·5	22·3	24·5	27·2	30·6	34·9	40·7	48·8	61·0	81·3	122	244	
21	16·6	17·7	19·0	20·6	22·5	24·7	27·4	30·8	35·2	41·0	49·2	61·4	81·9	123	246	
22	16·7	17·8	19·2	20·7	22·6	24·8	27·6	31·0	35·4	41·3	49·5	61·8	82·4	124	247	
23	16·8	18·0	19·3	20·9	22·8	25·0	27·8	31·2	35·7	41·6	49·9	62·3	83·0	125	249	
24	16·9	18·1	19·5	21·1	22·9	25·2	28·0	31·5	35·9	41·9	50·2	62·8	83·7	125	251	
25	17·1	18·2	19·6	21·2	23·1	25·4	28·2	31·7	36·2	42·2	50·6	63·3	84·3	126	253	
26	17·2	18·4	19·8	21·4	23·3	25·6	28·4	32·0	36·5	42·6	51·1	63·8	85·0	128	255	
27	17·3	18·6	20·0	21·6	23·5	25·8	28·7	32·3	36·8	42·9	51·5	64·4	85·8	129	257	
28	17·5	18·7	20·1	21·8	23·7	26·1	29·0	32·6	37·2	43·3	52·0	64·9	86·6	130	260	
29	17·7	18·9	20·3	22·0	24·0	26·3	29·2	32·9	37·5	43·8	52·5	65·6	87·4	131	262	
30	17·8	19·1	20·5	22·2	24·2	26·6	29·5	33·2	37·9	44·2	53·0	66·2	88·3	132	265	
31	18·0	19·3	20·7	22·4	24·5	26·9	29·8	33·5	38·3	44·6	53·5	66·9	89·2	134	267	
32	18·2	19·5	21·0	22·7	24·7	27·2	30·2	33·9	38·7	45·1	54·1	67·6	90·1	135	270	
33	18·4	19·7	21·2	22·9	25·0	27·5	30·5	34·3	39·1	45·6	54·7	68·4	91·1	137	273	
34	18·6	19·9	21·4	23·2	25·3	27·8	30·8	34·7	39·6	46·2	55·4	69·2	92·2	138	276	
35	18·9	20·2	21·7	23·5	25·6	28·1	31·2	35·1	40·1	46·7	56·0	70·0	93·3	140	280	
36	19·1	20·4	22·0	23·8	25·9	28·5	31·6	35·5	40·6	47·3	56·7	70·9	94·5	142	283	
37	19·4	20·7	22·3	24·1	26·2	28·8	32·0	36·0	41·1	47·9	57·5	71·8	95·7	144	287	
38	19·6	21·0	22·6	24·4	26·6	29·2	32·4	36·5	41·7	48·6	58·2	72·8	97·0	145	291	
39	19·9	21·3	22·9	24·8	27·0	29·6	32·9	37·0	42·2	49·2	59·1	73·8	98·3	147	295	
40	20·2	21·6	23·2	25·1	27·4	30·1	33·4	37·5	42·8	50·0	59·9	74·9	99·8	150	299	
41	20·5	21·9	23·6	25·5	27·8	30·5	33·9	38·1	43·5	50·7	60·8	76·0	101	152	304	
42	20·8	22·2	23·9	25·9	28·2	31·0	34·4	38·7	44·2	51·5	61·8	77·2	103	154	308	
43	21·1	22·6	24·3	26·3	28·7	31·5	35·0	39·3	44·9	52·3	62·8	78·4	105	157	313	
44	21·5	23·0	24·7	26·7	29·1	32·0	35·5	40·0	45·6	53·2	63·8	79·7	106	159	319	
45	21·9	23·4	25·1	27·2	29·6	32·6	36·2	40·6	46·4	54·1	64·9	81·1	108	162	324	
46	22·2	23·8	25·6	27·7	30·2	33·2	36·8	41·4	47·2	55·1	66·1	82·5	110	165	330	
47	22·7	24·2	26·1	28·2	30·7	33·8	37·5	42·1	48·1	56·1	67·3	84·1	112	168	336	
48	23·1	24·7	26·6	28·8	31·3	34·4	38·2	43·0	49·1	57·2	68·6	85·7	114	171	343	
49	23·6	25·2	27·1	29·3	32·0	35·1	39·0	43·8	50·0	58·3	70·0	87·4	116	175	349	
50	24·0	25·7	27·7	29·9	32·6	35·8	39·8	44·7	51·1	59·5	71·4	89·2	119	178	357	
51	24·6	26·3	28·3	30·6	33·3	36·6	40·6	45·7	52·2	60·8	72·9	91·1	121	182	364	
52	25·1	26·9	28·9	31·2	34·1	37·4	41·5	46·7	53·3	62·2	74·5	93·1	124	186	372	
53	25·7	27·5	29·5	32·0	34·8	38·3	42·5	47·8	54·5	63·6	76·3	95·3	127	190	381	
54	26·3	28·1	30·3	32·7	35·7	39·2	43·5	48·9	55·8	65·1	78·1	97·6	130	195	390	
55	26·9	28·8	31·0	33·5	36·5	40·2	44·6	50·1	57·2	66·7	80·0	100·0	133	200	400	
56	27·6	29·6	31·8	34·4	37·5	41·2	45·7	51·4	58·7	68·4	82·1	102·5	137	205	410	
57	28·4	30·4	32·6	35·3	38·5	42·3	46·9	52·8	60·3	70·3	84·3	105·3	140	210	421	
58	29·2	31·2	33·6	36·3	39·6	43·5	48·3	54·2	61·9	72·2	86·6	108·2	144	216	432	
59	30·0	32·1	34·5	37·4	40·7	44·7	49·6	55·8	63·7	74·3	89·1	111·3	148	223	445	
60	30·9	33·1	35·6	38·5	41·9	46·1	51·1	57·5	65·6	76·5	91·8	114·7	153	229	458	

To convert time into longitude divide by 4. Thus 35·6 s. ÷ 4 = 8·9′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Azimuths.	LATITUDES.														
	61°	62°	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°	75°
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
0	945	976	1010	1046	1085	1127	1173	1224	1279	1340	1408	1483	1568	1663	1771
0½	473	488	505	523	542	563	587	612	640	670	704	742	784	832	886
1	315	325	337	349	362	376	391	408	426	447	469	495	523	554	590
1½	236	244	252	262	271	282	293	306	320	335	352	371	392	416	443
2	189	195	202	209	217	225	235	245	256	268	282	297	314	333	354
2½	158	163	168	174	181	188	196	204	213	223	235	247	261	277	295
3	135	140	144	150	155	161	168	175	183	192	201	212	224	237	253
3½	118	122	126	131	136	141	147	153	160	168	176	186	196	208	222
4	105	109	112	116	121	125	130	136	142	149	157	165	174	185	197
4½	94·7	97·8	101	105	109	113	117	123	128	134	141	149	157	167	177
5	86·1	88·9	91·9	95·2	98·8	103	107	111	116	122	128	135	143	151	161
5½	79·1	81·5	84·3	87·3	90·5	94·1	97·9	102	107	112	118	124	131	139	148
6	72·9	75·3	77·8	80·6	83·6	86·9	90·4	94·3	98·6	103	109	114	121	128	137
6½	67·7	69·9	72·3	74·9	77·7	80·7	84·0	87·6	91·6	96·0	101	106	112	119	127
7	63·2	65·3	67·5	69·9	72·5	75·3	78·4	81·8	85·5	89·6	94·1	99·2	105	111	118
7½	59·3	61·2	63·3	65·6	68·0	70·7	73·6	76·7	80·2	84·0	88·3	93·0	98·3	104	111
8	55·8	57·6	59·6	61·7	64·0	66·5	69·3	72·2	75·5	79·1	83·1	87·6	92·6	98·2	105
8½	52·7	54·5	56·3	58·3	60·5	62·9	65·4	68·3	71·4	74·8	78·5	82·7	87·5	92·8	98·8
9	50·0	51·6	53·4	55·3	57·3	59·6	62·0	64·7	67·6	70·9	74·4	78·4	82·9	87·9	93·6
9½	47·5	49·1	50·7	52·6	54·5	56·6	59·0	61·5	64·3	67·4	70·8	74·5	78·8	83·6	89·0
10	45·3	46·8	48·3	50·1	51·9	54·0	56·2	58·6	61·2	64·2	67·4	71·0	75·1	79·6	84·8
10½	43·2	44·7	46·2	47·8	49·6	51·5	53·7	56·0	58·5	61·3	64·4	67·8	71·7	76·1	81·0
11	41·4	42·7	44·2	45·8	47·5	49·3	51·3	53·6	56·0	58·7	61·6	64·9	68·6	72·8	77·5
11½	39·7	41·0	42·4	43·9	45·5	47·3	49·2	51·4	53·7	56·3	59·1	62·3	65·8	69·8	74·3
12	38·1	39·4	40·7	42·2	43·7	45·4	47·3	49·3	51·6	54·0	56·8	59·8	63·2	67·0	71·4
12½	36·7	37·9	39·2	40·6	42·1	43·7	45·5	47·5	49·6	52·0	54·6	57·5	60·8	64·5	68·7
13	35·3	36·5	37·7	39·1	40·5	42·1	43·9	45·7	47·8	50·1	52·6	55·4	58·6	62·2	66·2
13½	34·1	35·2	36·4	37·7	39·1	40·7	42·3	44·1	46·1	48·3	50·8	53·5	56·6	60·0	63·9
14	33·0	34·0	35·2	36·4	37·8	39·3	40·9	42·6	44·6	46·7	49·1	51·7	54·6	58·0	61·7
14½	31·9	32·9	34·0	35·3	36·6	38·0	39·6	41·3	43·1	45·2	47·5	50·0	52·9	56·1	59·7
15	30·9	31·9	33·0	34·1	35·4	36·8	38·3	40·0	41·8	43·8	46·0	48·4	51·2	54·3	57·8
15½	29·9	30·9	32·0	33·1	34·3	35·7	37·1	38·7	40·5	42·4	44·6	47·0	49·6	52·6	56·1
16	29·1	30·0	31·0	32·1	33·3	34·6	36·0	37·6	39·3	41·2	43·3	45·6	48·2	51·1	54·4
16½	28·2	29·1	30·1	31·2	32·4	33·6	35·0	36·5	38·2	40·0	42·0	44·3	46·8	49·6	52·9
17	27·4	28·3	29·3	30·3	31·5	32·7	34·0	35·5	37·1	38·9	40·9	43·0	45·5	48·3	51·4
17½	26·7	27·6	28·5	29·5	30·6	31·8	33·1	34·6	36·1	37·8	39·8	41·9	44·3	47·0	50·0
18	26·0	26·9	27·8	28·8	29·8	31·0	32·3	33·7	35·2	36·9	38·7	40·8	43·1	45·7	48·7
18½	25·3	26·2	27·1	28·0	29·1	30·2	31·4	32·8	34·3	35·9	37·7	39·8	42·0	44·6	47·5
19	24·7	25·5	26·4	27·3	28·4	29·5	30·7	32·0	33·4	35·0	36·8	38·8	41·0	43·5	46·3
19½	24·1	24·9	25·8	26·7	27·7	28·8	29·9	31·2	32·6	34·2	35·9	37·8	40·0	42·4	45·2
20	23·6	24·3	25·2	26·1	27·0	28·1	29·2	30·5	31·9	33·4	35·1	37·0	39·1	41·4	44·1
20½	23·0	23·8	24·6	25·5	26·4	27·4	28·6	29·8	31·1	32·6	34·3	36·1	38·2	40·5	43·1
21	22·5	23·2	24·0	24·9	25·8	26·8	27·9	29·1	30·5	31·9	33·5	35·3	37·3	39·6	42·2
21½	22·0	22·7	23·5	24·4	25·3	26·3	27·3	28·5	29·8	31·2	32·8	34·6	36·5	38·7	41·3
22	21·6	22·3	23·0	23·8	24·7	25·7	26·8	27·9	29·2	30·6	32·1	33·8	35·8	37·9	40·4
22½	21·1	21·8	22·5	23·3	24·2	25·2	26·2	27·3	28·6	29·9	31·4	33·1	35·0	37·1	39·6
23	20·7	21·4	22·1	22·9	23·7	24·7	25·7	26·8	28·0	29·3	30·8	32·5	34·3	36·4	38·8
23½	20·3	20·9	21·7	22·4	23·3	24·2	25·2	26·3	27·4	28·8	30·2	31·8	33·6	35·7	38·0
24	19·9	20·5	21·2	22·0	22·8	23·7	24·7	25·7	26·9	28·2	29·6	31·2	33·0	35·0	37·3
24½	19·5	20·2	20·8	21·6	22·4	23·3	24·2	25·3	26·4	27·7	29·1	30·6	32·4	34·3	36·6
25	19·2	19·8	20·5	21·2	22·0	22·8	23·8	24·8	25·9	27·2	28·5	30·1	31·8	33·7	35·9
25½	18·8	19·4	20·1	20·8	21·6	22·4	23·4	24·4	25·5	26·7	28·0	29·5	31·2	33·1	35·3
26	18·5	19·1	19·7	20·4	21·2	22·0	22·9	23·9	25·0	26·2	27·5	29·0	30·7	32·5	34·6
26½	18·2	18·8	19·4	20·1	20·8	21·7	22·5	23·5	24·6	25·8	27·1	28·5	30·1	32·0	34·0
27	17·9	18·5	19·1	19·8	20·5	21·3	22·2	23·1	24·2	25·3	26·6	28·0	29·6	31·4	33·5
27½	17·6	18·1	18·8	19·4	20·2	20·9	21·8	22·7	23·8	24·9	26·2	27·6	29·1	30·9	32·9
28	17·3	17·9	18·5	19·1	19·8	20·6	21·5	22·4	23·4	24·5	25·7	27·1	28·7	30·4	32·4
28½	17·0	17·6	18·2	18·8	19·5	20·3	21·1	22·0	23·0	24·1	25·3	26·7	28·2	29·9	31·9
29	16·8	17·3	17·9	18·5	19·2	20·0	20·8	21·7	22·7	23·8	25·0	26·3	27·8	29·5	31·4
29½	16·5	17·0	17·6	18·2	18·9	19·7	20·5	21·4	22·3	23·4	24·6	25·9	27·4	29·0	30·9
30															

To convert time into longitude divide by 4. Thus 29·2s. ÷ by 4 = 7·3′ longitude.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Azimuths.	LATITUDES.															
	76°	77°	78°	79°	80°	80½°	81°	81½°	82°	82½°	83°	83½°	84°	84½°	85°
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
0	1895	2038	2205	2402	2640	2777	2930	3101	3294	3512	3761	4049	4385	4782	5259
0½	1895	2038	2205	2402	2640	2777	2930	3101	3294	3512	3761	4049	4385	4782	5259
1	947	1019	1102	1201	1320	1389	1466	1551	1647	1756	1881	2025	2193	2391	2630
1½	632	679	735	801	880	926	977	1034	1098	1171	1254	1350	1462	1594	1753
2	474	510	551	601	660	694	733	775	824	878	940	1012	1096	1193	1315
2½	379	408	441	481	528	556	586	620	659	703	752	810	877	957	1052
3	316	340	368	401	440	463	489	517	549	586	627	675	731	797	877
3½	271	291	315	343	377	397	419	443	471	502	538	579	627	684	752
4	237	255	276	301	330	347	367	388	412	439	471	507	549	598	658
4½	211	227	245	267	294	309	326	345	366	391	418	450	488	532	585
5	190	204	221	241	264	278	293	310	330	352	377	405	439	479	527
5½	173	186	201	219	240	253	267	282	300	320	342	369	399	435	479
6	158	170	184	201	220	232	245	259	275	293	314	338	366	399	439
6½	146	157	170	185	203	214	226	239	254	271	290	312	338	369	405
7	136	146	158	172	189	199	210	222	236	251	269	290	314	343	377
7½	127	136	147	161	176	186	196	207	220	235	251	271	293	320	352
8	119	128	138	151	166	174	184	194	207	220	236	254	275	300	330
8½	112	120	130	142	156	164	173	183	194	207	222	239	259	282	311
9	106	114	123	134	147	155	163	173	184	196	210	226	245	267	293
9½	100	108	117	127	140	147	155	164	174	186	199	214	232	253	278
10	95·2	102	111	121	133	140	147	156	166	176	189	203	220	240	264
10½	90·7	97·6	106	115	126	133	140	148	158	168	180	194	210	229	252
11	86·7	93·2	101	110	121	127	134	142	151	161	172	185	201	219	241
11½	82·9	89·2	96·5	105	116	122	128	136	144	154	165	177	192	209	230
12	79·5	85·5	92·5	101	111	117	123	130	138	147	158	170	184	201	221
12½	76·4	82·2	88·9	96·9	106	112	118	125	133	142	152	163	177	193	212
13	73·5	79·0	85·5	93·2	102	108	114	120	128	136	146	157	170	186	204
13½	70·8	76·2	82·4	89·8	98·7	104	110	116	123	131	141	151	164	179	197
14	68·3	73·5	79·5	86·7	95·2	100	106	112	119	127	136	146	158	173	190
14½	66·0	71·0	76·8	83·7	92·0	96·8	102	108	115	122	131	141	153	167	183
15	63·9	68·7	74·3	81·0	89·0	93·6	98·8	105	111	118	127	137	148	161	177
15½	61·9	66·5	72·0	78·4	86·2	90·7	95·7	101	108	115	123	132	143	156	172
16	60·0	64·5	69·8	76·0	83·6	87·9	92·8	98·2	104	111	119	128	139	151	167
16½	58·2	62·6	67·7	73·8	81·1	85·3	90·0	95·3	101	108	116	124	135	147	161
17	56·6	60·8	65·8	71·7	78·8	82·9	87·5	92·6	98·3	105	112	121	131	143	157
17½	55·0	59·1	64·0	69·7	76·6	80·6	85·0	90·0	95·6	102	109	118	127	139	153
18	53·5	57·5	62·3	67·8	74·5	78·4	82·7	87·6	93·0	99·2	106	114	124	135	149
18½	52·1	56·0	60·6	66·1	72·6	76·4	80·6	85·3	90·6	96·6	103	111	121	132	145
19	50·8	54·6	59·1	64·4	70·8	74·4	78·5	83·1	88·3	94·1	101	109	118	128	141
19½	49·5	53·3	57·6	62·8	69·0	72·6	76·6	81·1	86·1	91·8	98·3	106	115	125	137
20	48·3	52·0	56·3	61·3	67·4	70·9	74·8	79·1	84·0	89·6	96·0	103	112	122	134
20½	47·2	50·8	54·9	59·9	65·8	69·2	73·0	77·3	82·1	87·5	93·7	101	109	119	131
21	46·1	49·6	53·7	58·5	64·3	67·6	71·4	75·5	80·2	85·5	91·6	98·6	107	116	128
21½	45·1	48·5	52·5	57·2	62·9	66·1	69·8	73·8	78·4	83·6	89·6	96·4	104	114	125
22	44·1	47·5	51·4	56·0	61·5	64·7	68·3	72·2	76·7	81·8	87·6	94·3	102	111	123
22½	43·2	46·5	50·3	54·8	60·2	63·3	66·8	70·7	75·1	80·1	85·8	92·3	100	109	120
23	42·3	45·5	49·2	53·7	59·0	62·0	65·4	69·3	73·6	78·4	84·0	90·4	97·9	107	117
23½	41·5	44·6	48·2	52·6	57·8	60·8	64·1	67·9	72·1	76·9	82·3	88·6	96·0	105	115
24	40·7	43·7	47·3	51·5	56·6	59 6	62·9	66·5	70·7	75·3	80·7	86·9	94·1	103	113
24½	39·9	42·9	46·4	50·5	55·5	58·4	61·7	65·3	69·3	73·9	79·1	85·2	92·3	101	111
25	39·1	42·1	45·5	49·6	54·5	57·3	60·5	64·0	68·0	72·5	77·7	83·6	90·5	98·8	109
25½	38·4	41·3	44·7	48·7	53·5	56·3	59·4	62 9	66·8	71·2	76·2	82·1	88·9	96·9	107
26	37·7	40·6	43·9	47·8	52·5	55·3	58·3	61·7	65·6	69·9	74·9	80·6	87·3	95·2	105
26½	37·1	39·9	43·1	47·0	51·6	54·3	57·3	60·6	64·4	68·7	73·6	79·2	85·8	93·5	103
27	36·4	39·2	42·4	46·2	50·7	53·4	56·3	59·6	63·3	67·5	72·3	77·8	84·3	91·9	101
27½	35·8	38·5	41·7	45·4	49·9	52·5	55·4	58·6	62·2	66·4	71·1	76·5	82·9	90·4	99·4
28	35·2	37·9	41·0	44·7	49·1	51·6	54·5	57·6	61·2	65·3	69·9	75·3	81·5	88·9	97·8
28½	34·7	37·3	40·3	43·9	48·3	50·8	53·6	56·7	60·2	64·2	68·8	74·1	80·2	87·5	96·2
29	34·1	36·7	39·7	43·2	47·5	50·0	52·7	55·8	59·3	63·2	67·7	72·9	78·9	86·1	94·7
29½	33·6	36·1	39·1	42·6	46·8	49·2	51·9	55·0	58·4	62·2	66·7	71·8	77·7	84·8	93·2
30	33·1	35·6	38·5	41·9	46·1	48·5	51·1	54·1	57·5	61·3	65·6	70·7	76·5	83·5	91·8

To convert time into longitude divide by 4. Thus 50·8s. ÷ by 4 = 12·7′ longitude.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Azimuths.	LATITUDES.														
	61°	62°	63°	64°	65°	66°	67°	68°	69°	69½°	70°	70½°	71°	71½°	72°
°	s.	s.	s	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
30	16·5	17·0	17·6	18·2	18·9	19·7	20·5	21·4	22·3	22·8	23·4	24·0	24·6	25·2	25·9
31	16·0	16·5	17·1	17·7	18·4	19·1	19·9	20·7	21·7	22·2	22·7	23·3	23·9	24·5	25·1
32	15·6	16·1	16·6	17·2	17·9	18·6	19·3	20·1	21·1	21·6	22·1	22·6	23·2	23·8	24·4
33	15·1	15·6	16·2	16·8	17·4	18·1	18·8	19·6	20·5	21·0	21·5	22·0	22·6	23·1	23·8
34	14·8	15·2	15·8	16·3	16·9	17·6	18·3	19·1	20·0	20·4	20·9	21·4	22·0	22·5	23·1
35	14·4	14·9	15·4	15·9	16·5	17·1	17·8	18·6	19·5	19·9	20·4	20·9	21·4	22·0	22·6
36	14·0	14·5	15·0	15·5	16·1	16·7	17·4	18·2	19·0	19·4	19·9	20·4	20·9	21·4	22·0
37	13·7	14·2	14·6	15·2	15·7	16·3	17·0	17·7	18·5	19·0	19·4	19·9	20·4	20·9	21·5
38	13·4	13·8	14·3	14·8	15·4	16·0	16·6	17·3	18·1	18·6	19·0	19·5	20·0	20·5	21·0
39	13·1	13·5	14·0	14·5	15·0	15·6	16·3	17·0	17·7	18·1	18·6	19·0	19·5	20·0	20·6
40	12·8	13·3	13·7	14·2	14·7	15·3	15·9	16·6	17·4	17·8	18·2	18·6	19·1	19·6	20·1
41	12·6	13·0	13·4	13·9	14·4	15·0	15·6	16·3	17·0	17·4	17·8	18·3	18·7	19·2	19·7
42	12·3	12·7	13·2	13·6	14·1	14·7	15·3	16·0	16·7	17·1	17·5	17·9	18·4	18·8	19·3
43	12·1	12·5	12·9	13·4	13·9	14·4	15·0	15·7	16·4	16·7	17·1	17·6	18·0	18·5	19·0
44	11·9	12·3	12·7	13·1	13·6	14·2	14·7	15·4	16·1	16·4	16·8	17·3	17·7	18·1	18·6
45	11·7	12·0	12·5	12·9	13·4	13·9	14·5	15·1	15·8	16·2	16·5	16·9	17·4	17·8	18·3
46	11·5	11·8	12·2	12·7	13·2	13·7	14·2	14·8	15·5	15·9	16·3	16·7	17·1	17·5	18·0
47	11·3	11·6	12·0	12·5	12·9	13·4	14·0	14·6	15·3	15·6	16·0	16·4	16·8	17·2	17·7
48	11·1	11·5	11·9	12·3	12·7	13·2	13·8	14·4	15·0	15·4	15·7	16·1	16·5	17·0	17·4
49	10·9	11·3	11·7	12·1	12·5	13·0	13·6	14·1	14·8	15·1	15·5	15·9	16·3	16·7	17·2
50	10·8	11·1	11·5	11·9	12·4	12·8	13·4	13·9	14·6	14·9	15·3	15·6	16·0	16·5	16·9
51	10·6	11·0	11·3	11·7	12·2	12·7	13·2	13·7	14·4	14·7	15·0	15·4	15·8	16·2	16·7
52	10·5	10·8	11·2	11·6	12·0	12·5	13·0	13·6	14·2	14·5	14·8	15·2	15·6	16·0	16·4
53	10·3	10·7	11·0	11·4	11·9	12·3	12·8	13·4	14·0	14·3	14·6	15·0	15·4	15·8	16·2
54	10·2	10·5	10·9	11·3	11·7	12·2	12·7	13·2	13·8	14·1	14·5	14·8	15·2	15·6	16·0
55	10·1	10·4	10·8	11·1	11·5	12·0	12·5	13·0	13·6	13·9	14·3	14·6	15·0	15·4	15·8
56	9·95	10·3	10·6	11·0	11·4	11·9	12·3	12·9	13·5	13·8	14·1	14·5	14·8	15·2	15·6
57	9·84	10·2	10·5	10·9	11·3	11·7	12·2	12·7	13·3	13·6	13·9	14·3	14·6	15·0	15·4
58	9·73	10·0	10·4	10·8	11·2	11·6	12·1	12·6	13·2	13·5	13·8	14·1	14·5	14·9	15·3
59	9·63	9·94	10·3	10·6	11·0	11·5	11·9	12·5	13·0	13·3	13·6	14·0	14·3	14·7	15·1
60	9·53	9·84	10·2	10·5	10·9	11·4	11·8	12·3	12·9	13·2	13·5	13·8	14·2	14·6	14·9
61	9·43	9·74	10·1	10·4	10·8	11·2	11·7	12·2	12·8	13·1	13·4	13·7	14·0	14·4	14·8
62	9·34	9·65	10·0	10·3	10·7	11·1	11·6	12·1	12·6	12·9	13·2	13·6	13·9	14·3	14·7
63	9·26	9·56	9·89	10·2	10·6	11·0	11·5	12·0	12·5	12·8	13·1	13·4	13·8	14·1	14·5
64	9·18	9·48	9·80	10·2	10·5	10·9	11·4	11·9	12·4	12·7	13·0	13·3	13·7	14·0	14·4
65	9·10	9·40	9·72	10·1	10·4	10·9	11·3	11·8	12·3	12·6	12·9	13·2	13·6	13·9	14·3
66	9·03	9·33	9·64	9·99	10·4	10·8	11·2	11·7	12·2	12·5	12·8	13·1	13·4	13·8	14·2
67	8·96	9·26	9·57	9·91	10·3	10·7	11·1	11·6	12·1	12·4	12·7	13·0	13·3	13·7	14·1
68	8·90	9·19	9·50	9·84	10·2	10·6	11·0	11·5	12·0	12·3	12·6	12·9	13·3	13·6	14·0
69	8·84	9·13	9·44	9·77	10·1	10·5	11·0	11·4	12·0	12·2	12·5	12·8	13·2	13·5	13·9
70	8·78	9·07	9·38	9·71	10·1	10·5	10·9	11·4	11·9	12·2	12·4	12·8	13·1	13·4	13·8
71	8·73	9·01	9·32	9·65	10·0	10·4	10·8	11·3	11·8	12·1	12·4	12·7	13·0	13·3	13·7
72	8·68	8·96	9·26	9·59	9·95	10·3	10·8	11·2	11·7	12·0	12·3	12·6	12·9	13·3	13·6
73	8·63	8·91	9·21	9·54	9·90	10·3	10·7	11·2	11·7	11·9	12·2	12·5	12·8	13·2	13·5
74	8·58	8·86	9·17	9·49	9·85	10·2	10·6	11·1	11·6	11·9	12·2	12·5	12·8	13·1	13·5
75	8·54	8·82	9·12	9·45	9·80	10·2	10·6	11·1	11·6	11·8	12·1	12·4	12·7	13·1	13·4
76	8·50	8·78	9·08	9·40	9·75	10·1	10·6	11·0	11·5	11·8	12·1	12·3	12·7	13·0	13·3
77	8·47	8·74	9·04	9·36	9·71	10·1	10·5	11·0	11·5	11·7	12·0	12·3	12·6	12·9	13·3
78	8·44	8·71	9·01	9·33	9·68	10·1	10·5	10·9	11·4	11·7	12·0	12·3	12·6	12·9	13·2
79	8·41	8·68	8·98	9·30	9·64	10·0	10·4	10·9	11·4	11·6	11·9	12·2	12·5	12·8	13·2
80	8·38	8·65	8·95	9·27	9·61	9·99	10·4	10·8	11·3	11·6	11·9	12·2	12·5	12·8	13·1
81	8·35	8·63	8·92	9·24	9·58	9·96	10·4	10·8	11·3	11·6	11·8	12·1	12·4	12·8	13·1
82	8·33	8·60	8·90	9·21	9·56	9·93	10·3	10·8	11·3	11·5	11·8	12·1	12·4	12·7	13·1
83	8·31	8·58	8·88	9·19	9·54	9·91	10·3	10·8	11·2	11·5	11·8	12·1	12·4	12·7	13·0
84	8·30	8·57	8·87	9·17	9·52	9·89	10·3	10·7	11·2	11·5	11·8	12·0	12·4	12·7	13·0
85	8·28	8·55	8·84	9·16	9·50	9·87	20·3	10·7	11·2	11·5	11·7	12·0	12·3	12·7	13·0
86	8·27	8·54	8·83	9·15	9·49	9·86	10·3	10·7	11·2	11·4	11·7	12·0	12·3	12·6	13·0
87	8·26	8·53	8·82	9·14	9·48	9·85	10·3	10·7	11·2	11·4	11·7	12·0	12·3	12·6	13·0
88	8·26	8·53	8·82	9·13	9·47	9·84	10·2	10·7	11·2	11·4	11·7	12·0	12·3	12·6	13·0
89	8·25	8·52	8·81	9·13	9·47	9·84	10·2	10·7	11·2	11·4	11·7	12·0	12·3	12·6	12·9
90	8·25	8·52	8·81	9·12	9·46	9·83	10·2	10·7	11·2	11·4	11·7	12·0	12·3	12·6	12·9

To convert time into longitude divide by 4. Thus 12 s. ÷ 4 = 3′ long.

Table D.

SHOWING THE ERROR PRODUCED IN THE TIME OR LONGITUDE BY AN ERROR OF 1′ IN THE ALTITUDE.

Azimuths.	LATITUDES.														
	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	83½°	84°	84½°	85°
°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
30	27·4	29·0	30·9	33·1	35·6	38·5	41·9	46·1	51·1	57·5	65·6	70·7	76·5	83·5	91·8
31	26·6	28·2	30·0	32·1	34·5	37·4	40·7	44·7	49·6	55·8	63·7	68·6	74·3	81·0	89·1
32	25.8	27·4	29·2	31·2	33·6	36·3	39·6	43·5	48·3	54·2	61·9	66·7	72·2	78·8	86·6
33	25·1	26·6	28·4	30·4	32·6	35·3	38·5	42·3	46·9	52·8	60·3	64·9	70·3	76·6	84·3
34	24·5	26·0	27·6	29·6	31·8	34·4	37·5	41·2	45·7	51·4	58·7	63·2	68·4	74·6	82·1
35	23·9	25·3	26·9	28·8	31·0	33·5	36·5	40·2	44·6	50·1	57·2	61·6	66·7	72·8	80·0
36	23·3	24·7	26·3	28·1	30·3	32·7	35·7	39·2	43·5	48·9	55·8	60·1	65·1	71·0	78·1
37	22·7	24·1	25·7	27·5	29·5	32·0	34·8	38·3	42·5	47·8	54·5	58·7	63·6	69·4	76·3
38	22·2	23·6	25·1	26·9	28·9	31·2	34·0	37·4	41·5	46·7	53·3	57·4	62·2	67·8	74·5
39	21·7	23·1	24·6	26·3	28·3	30·6	33·3	36·6	40·6	45·7	52·2	56·1	60·8	66·3	72·9
40	21·3	22·6	24·0	25·7	27·7	29·9	32·6	35·8	39·8	44·7	51·1	55·0	59·5	64·9	71·4
41	20·9	22·1	23·6	25·2	27·1	29·3	32·0	35·1	39·0	43·8	50·0	53·9	58·3	63·6	70·0
42	20·4	21·7	23·1	24·7	26·6	28·8	31·3	34·4	38·2	43·0	49·1	52·8	57·2	62·4	68·6
43	20·1	21·3	22·7	24·2	26·1	28·2	30·7	33·8	37·5	42·1	48·1	51·8	56·1	61·2	67·3
44	19·7	20·9	22·2	23·8	25·6	27·7	30·2	33·2	36·8	41·4	47·2	50·9	55·1	60·1	66·1
45	19·3	20·5	21·9	23·4	25·1	27·2	29·6	32·6	36·2	40·6	46·4	50·0	54·1	59·0	64·9
46	19·0	20·2	21·5	23·0	24·7	26·7	29·1	32·0	35·5	40·0	45·6	49·1	53·2	58·0	63·8
47	18·7	19·8	21·1	22·6	24·3	26·3	28·7	31·5	35·0	39·3	44·9	48·3	52·3	57·1	62·7
48	18·4	19·5	20·8	22·2	23·9	25·9	28·2	31·0	34·4	38·7	44·2	47·5	51·5	56·2	61·8
49	18·1	19·2	20·5	21·9	23·6	25·5	27·8	30·5	33·9	38·1	43·5	46·8	50·7	55·3	60·8
50	17·9	18·9	20·2	21·6	23·2	25·1	27·4	30·1	33·4	37·5	42·9	46·1	50·0	54·5	59·9
51	17·6	18·7	19·9	21·3	22·9	24·8	27·0	29·6	32·9	37·0	42·2	45·5	49·2	53·7	59·1
52	17·4	18·4	19·6	21·0	22·6	24·4	26·6	29·2	32·5	36·5	41·7	44·8	48·6	53·0	58·2
53	17·1	18·2	19·4	20·7	22·3	24·1	26·2	28·8	32·0	36·0	41·1	44·2	47·9	52·3	57·5
54	16·9	17·9	19·1	20·4	22·0	23·8	25·9	28·5	31·6	35·5	40·6	43·7	47·3	51·6	56·7
55	16·7	17·7	18·9	20·2	21·7	23·5	25·6	28·1	31·2	35·1	40·1	43·1	46·7	50·9	56·0
56	16·5	17·5	18·6	19·9	21·4	23·2	25·3	27·8	30·8	34·7	39·6	42·6	46·2	50·3	55·4
57	16·3	17·3	18·4	19·7	21·2	22·9	25·0	27·5	30·5	34·3	39·1	42·1	45·6	49·8	54·7
58	16·1	17·1	18·2	19·5	21·0	22·7	24·7	27·2	30·2	33·9	38·7	41·7	45·1	49·2	54·1
59	16·0	16·9	18·0	19·3	20·7	22·4	24·5	26·9	29·8	33·5	38·3	41·2	44·6	48·7	53·5
60	15·8	16·8	17·8	19·1	20·5	22·2	24·2	26·6	29·5	33·2	37·9	40·8	44·2	48·2	53·0
61	15·6	16·6	17·7	18·9	20·3	22·0	24·0	26·3	29·2	32·9	37·5	40·4	43·8	47·7	52·5
62	15·5	16·4	17·5	18·7	20·1	21·8	23·7	26·1	29·0	32·6	37·2	40·0	43·3	47·3	52·0
63	15·3	16·3	71·3	18·6	20·0	21·6	23·5	25·9	28·7	32·3	36·8	39·7	42·9	46·8	51·5
64	15·2	16·1	17·2	18·4	19·8	21·4	23·3	25·6	28·4	32·0	36·5	39·3	42·6	46·4	51·1
65	15·1	16·0	17·1	18·2	19·6	21·2	23·1	25·4	28·2	31·7	36·2	39·0	42·2	46·0	50·6
66	15·0	15·9	16·9	18·1	19·5	21·1	22·9	25·2	28·0	31·5	35·9	38·7	41·9	45·7	50·2
67	14·9	15·8	16·8	18·0	19·3	20·9	22·8	25·0	27·8	31·2	35·7	38·4	41·6	45·3	49·9
68	14·8	15·7	16·7	17·8	19·2	20·7	22·6	24·8	27·6	31·0	35·4	38·1	41·3	45·0	49·5
69	14·7	15·5	16·6	17·7	19·0	20·6	22·5	24·7	27·4	30·8	35·2	37·8	41·0	44·7	49·2
70	14·6	15·4	16·4	17·6	18·9	20·5	22·3	24·5	27·2	30·6	34·9	37·6	40·7	44·4	48·8
71	14·5	15·3	16·3	17·5	18·8	20·3	22·2	24·4	27·0	30·4	34·7	37·4	40·5	44·1	48·5
72	14·4	15·3	16·3	17·4	18·7	20·2	22·0	24·2	26·9	30·2	34·5	37·2	40·2	43·9	48·3
73	14·3	15·2	16·2	17·3	18·6	20·1	21·9	24·1	26·7	30·1	34·3	36·9	40·1	43·6	48·0
74	14·2	15·1	16·1	17·2	18·5	20·0	21·8	24·0	26·6	29·9	34·1	36·8	39·8	43·4	47·7
75	14·2	15·0	16·0	17·1	18·4	19·9	21·7	23·8	26·5	29·8	34·0	36·6	39·6	43·2	47·5
76	14·1	15·0	15·9	17·0	18·3	19·8	21·6	23·7	26·4	29·6	33·8	36·4	39·4	43·0	47·3
77	14·0	14·9	15·9	17·0	18·2	19·7	21·5	23·6	26·2	29·5	33·7	36·3	39·3	42·8	47·1
78	14·0	14·8	15·8	16·9	18·2	19·7	21·4	23·5	26·1	29·4	33·6	36·1	39·1	42·7	46·9
79	13·9	14·8	15·7	16·8	18·1	19·6	21·4	23·5	26·0	29·3	33·4	36·0	39·0	42·5	46·8
80	13·9	14·7	15·7	16·8	18·1	19·5	21·3	23·4	26·0	29·2	33·3	35·9	38·9	42·4	46·6
81	13·9	14·7	15·6	16·7	18·0	19·5	21·2	23·3	25·9	29·1	33·2	35·8	38·7	42·3	46·5
82	13·8	14·7	15·6	16·7	18·0	19·4	21·2	23·3	25·8	29·0	33·1	35·7	38·6	42·1	46·3
83	13·8	14·6	15·6	16·7	17·9	19·4	21·1	23·2	25·8	29·0	33·1	35·6	38·6	42·0	46·2
84	13·8	14·6	15·5	16·6	17·9	19·3	21·1	23·2	25·7	28·9	33·0	35·5	38·5	42·0	46·1
85	13·7	14·6	15·5	16·6	17·8	19·3	21·0	23·2	25·7	28·9	32·9	35·5	38·4	41·9	46·1
86	13·7	14·5	15·5	16·6	17·8	19·3	21·0	23·1	25·6	28·8	32·9	35·4	38·4	41·8	46·0
87	13·7	14·5	15·5	16·6	17·8	19·3	21·0	23·1	25·6	28·8	32·9	35·4	38·3	41·8	46·0
88	13·7	14·5	15·5	16·5	17·8	19·2	21·0	23·0	25·6	28·8	32·8	35·4	38·3	41·8	45·9
89	13·7	14·5	15·5	16·5	17·8	19·2	21·0	23·0	25·6	28·7	32·8	35·3	38·3	41·7	45·9
90	13·7	14·5	15·5	16·5	17·8	19·2	21·0	23·0	25·6	28·7	32·8	35·3	38·3	41·7	45·9

Table E.

CORRECTIONS OF ALTITUDE OF THE SUN AND STARS
(Involving Dip, Refraction, ⊙'s Sem diameter, and Parallax).

Add the Cor. to the Alt. of the ⊙'s *Lower Limb*.

Sun's Obs. Alt.	Height of the Eye, in Feet.									
	6 ft.	8 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	22 ft.	24 ft.
°	′	′	′	′	′	′	′	′	′	′
5	3·9	3·5	3·1	2·8	2·5	2·2	1·9	1·7	1·5	1·3
6	5·2	4·8	4·5	4·2	3·9	3·7	3·4	3·2	2·9	2·7
7	6·4	5·9	5·6	5·3	5·0	4·8	4·5	4·3	4·0	3·8
8	7·2	6·8	6·5	6·2	5·9	5·6	5·4	5·2	4·9	4·7
9	7·9	7·5	7·2	6·8	6·6	6·3	6·1	5·8	5·6	5·4
10	8·4	8·0	7·7	7·4	7·1	6·9	6·6	6·4	6·2	6·0
11	8·9	8·5	8·2	7·9	7·6	7·4	7·1	6·9	6·7	6·5
12	9·3	8·9	8·6	8·3	8·0	7·8	7·5	7·3	7·1	6·9
13	9·6	9·2	8·9	8·6	8·4	8·1	7·9	7·6	7·4	7·2
14	9·9	9·5	9·2	8·9	8·6	8·4	8·1	7·9	7·7	7·5
15	10·2	9·8	9·5	9·2	8·9	8·6	8·4	8·2	8·0	7·8
16	10·4	10·0	9·7	9·4	9·1	8·9	8·6	8·4	8·2	8·0
17	10·6	10·3	9·9	9·6	9·4	9·1	8·9	8·6	8·4	8·2
18	10·8	10·4	10·1	9·8	9·5	9·3	9·0	8·8	8·6	8·4
19	10·9	10·6	10·3	9·9	9·7	9·4	9·2	8·9	8·7	8·5
20	11·1	10·7	10·4	10·1	9·8	9·6	9·3	9·1	8·9	8·7
22	11·3	11·0	10·7	10·3	10·1	9·8	9·6	9·4	9·2	9·0
24	11·6	11·2	10·9	10·6	10·3	10·0	9·8	9·6	9·4	9·2
26	11·7	11·4	11·1	10·7	10·5	10·2	10·0	9·8	9·5	9·3
28	11·9	11·5	11·2	10·9	10·6	10·4	10·2	9·9	9·7	9·5
30	12·1	11·7	11·4	11·1	10·8	10·5	10·3	10·1	9·9	9·7
35	12·4	12·0	11·7	11·3	11·1	10·8	10·6	10·4	10·1	9·9
40	12·6	12·2	11·9	11·6	11·3	11·0	10·8	10·6	10·4	10·2
45	12·8	12·4	12·1	11·8	11·5	11·2	11·0	10·8	10·5	10·3
50	12·9	12·5	12·2	11·9	11·6	11·4	11·2	10·9	10·7	10·5
55	13·1	12·7	12·4	12·1	11·8	11·5	11·3	11·1	10·9	10·7
60	13·2	12·8	12·5	12·2	11·9	11·6	11·4	11·2	11·0	10·8
65	13·3	12·9	12·6	12·3	12·0	11·8	11·5	11·3	11·1	10·9
70	13·4	13·0	12·7	12·4	12·1	11·9	11·6	11·4	11·2	11·0
80	13·6	13·2	12·9	12·6	12·3	12·0	11·8	11·6	11·4	11·2
90	13·7	13·4	13·0	12·7	12·5	12·2	12·0	11·7	11·5	11·3

CORRECTION OF A STAR'S ALTITUDE. (*Subtract.*)

Star's Alt.	Height of the Eye, in Feet.									
	6 ft.	8 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	22 ft.	24 ft.
°	′	′	′	′	′	′	′	′	′	′
5	12·3	12·6	13·1	13·4	13·7	13·9	14·2	14·4	14·6	14·8
6	10·9	11·3	11·6	12·0	12·3	12·5	12·8	13·0	13·2	13·4
7	9·7	10·2	10·5	10·9	11·1	11·4	11·6	11·9	12·1	12·3
8	9·0	9·3	9·7	10·0	10·3	10·5	10·8	11·0	11·2	11·4
9	8·3	8·7	9·0	9·3	9·6	9·8	10·1	10·3	10·5	10·7
10	7·7	8·1	8·4	8·7	9·0	9·3	9·5	9·7	10·0	10·2
11	7·3	7·6	7·9	8·3	8·5	8·8	9·0	9·3	9·5	9·7
12	6·9	7·2	7·5	7·9	8·1	8·4	8·6	8·9	9·1	9·3
13	6·5	6·9	7·2	7·5	7·8	8·0	8·3	8·5	8·7	8·9
14	6·2	6·6	6·9	7·2	7·5	7·8	8·0	8·2	8·5	8·7
15	6·0	6·3	6·6	7·0	7·2	7·5	7·7	8·0	8·2	8·4
16	5·8	6·1	6·4	6·8	7·0	7·3	7·5	7·7	8·0	8·2
17	5·5	5·9	6·2	6·5	6·8	7·0	7·3	7·5	7·7	7·9
18	5·4	5·7	6·0	6·4	6·6	6·9	7·1	7·3	7·6	7·8
19	5·2	5·6	5·9	6·2	6·5	6·7	7·0	7·2	7·4	7·6
20	5·0	5·4	5·7	6·0	6·3	6·6	6·8	7·0	7·3	7·5
22	4·8	5·2	5·5	5·8	6·1	6·3	6·5	6·8	7·0	7·2
24	4·6	4·9	5·3	5·6	5·8	6·1	6·3	6·6	6·8	7·0
26	4·4	4·8	5·1	5·4	5·7	5·9	6·1	6·4	6·6	6·8
28	4·2	4·6	4·9	5·2	5·5	5·7	6·0	6·2	6·4	6·6
30	4·1	4·4	4·8	5·1	5·3	5·6	5·8	6·1	6·3	6·5
35	3·8	4·2	4·5	4·8	5·1	5·3	5·5	5·8	6·0	6·2
40	3·6	3·9	4·3	4·6	4·8	5·1	5·3	5·6	5·8	6·0
45	3·4	3·8	4·1	4·4	4·6	4·9	5·1	5·4	5·6	5·8
50	3·2	3·6	3·9	4·2	4·5	4·7	5·0	5·2	5·4	5·6
55	3·1	3·4	3·8	4·1	4·4	4·6	4·8	5·1	5·3	5·5
60	3·0	3·3	3·7	4·0	4·2	4·5	4·7	5·0	5·2	5·4
65	2·9	3·2	3·6	3·9	4·1	4·4	4·6	4·9	5·1	5·3
70	2·8	3·1	3·5	3·8	4·0	4·3	4·5	4·8	5·0	5·2
80	2·6	2·9	3·3	3·6	3·9	4·1	4·3	4·6	4·8	5·0
90	2·4	2·8	3·1	3·4	3·7	3·9	4·2	4·4	4·6	4·8

Table F.

Acceleration.				
H.	M.	S.	M.	S.
1	0	9·86	1	0·16
2	0	19·71	2	0·33
3	0	29·57	3	0·49
4	0	39·43	4	0·66
5	0	49·28	5	0·82
6	0	59·14	6	0·98
7	1	9·00	7	1·15
8	1	18·85	8	1·31
9	1	28·71	9	1·48
10	1	38·56	10	1·64
11	1	48·42	11	1·81
12	1	58·28	12	1·97
13	2	8·13	13	2·13
14	2	17·99	14	2·30
15	2	27·85	15	2·46
16	2	37·70	16	2·63
17	2	47·56	17	2·79
18	2	57·42	18	2·96
19	3	7·27	19	3·12
20	3	17·13	20	3·29
21	3	26·99	21	3·45
22	3	36·84	22	3·61
23	3	46·70	23	3·78
24	3	56·56	24	3·94
			25	4·11
			26	4·27
			27	4·44
			28	4·60
			29	4·76
			30	4·93
			31	5·09
			32	5·26
			33	5·42
			34	5·59
			35	5·75
			36	5·91
			37	6·08
			38	6·24
			39	6·40
			40	6·57
			41	6·74
			42	6·90
			43	7·06
			44	7·23
			45	7·39
			46	7·56
			47	7·72
			48	7·89
			49	8·05
			50	8·21
			51	8·38
			52	8·54
			53	8·71
			54	8·87
			55	9·04
			56	9·20
			57	9·36
			58	9·53
			59	9·69
			60	9·86

Month Cor. to Sun's Alt.	
Jan.	+ 0′·3
Feb.	+ 0·2
Mar.	+ 0·1
April	− 0·1
May	− 0·2
June	− 0·2
July	− 0·3
Aug.	− 0·2
Sep.	− 0·1
Oct.	+ 0·1
Nov.	+ 0·2
Dec.	+ 0·3

Table E.

CORRECTIONS OF ALTITUDE OF THE SUN AND STARS

(Involving Dip, Refraction, ⊙'s Semidiameter, and Parallax).

Add the Cor. to the Alt. of the ⊙'s *Lower Limb*, except *where marked* – (minus).

Sun's Obs. Alt.	Height of the Eye, in Feet.									
	26 ft.	28 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	55 ft.	60 ft.	70 ft.	80 ft.
°	′	′	′	′	′	′	′	′	′	′	′
5	1·1	0·9	0·7	0·3	−0·1	−0·5	−0·8	−1·2	−1·6	−2·8	−3·3
6	2·5	2·4	2·2	1·7	1·3	0·9	0·6	0·2	−0·1	−0·7	−1·3
7	3·6	3·5	3·3	2·8	2·4	2·1	1·7	1·3	1·0	0·4	−0·2
8	4·5	4·3	4·2	3·7	3·3	3·0	2·6	2·2	1·9	1·3	0·7
9	5·2	5·0	4·8	4·4	4·0	3·6	3·3	2·9	2·6	2·0	1·4
10	5·8	5·6	5·4	5·0	4·6	4·2	3·8	3·5	3·2	2·5	2·0
11	6·3	6·1	5·9	5·5	5·0	4·7	4·3	4·0	3·6	3·0	2·5
12	6·7	6·5	6·3	5·9	5·5	5·1	4·7	4·4	4·1	3·5	2·9
13	7·0	6·8	6·6	6·2	5·8	5·4	5·1	4·7	4·4	3·8	3·2
14	7·3	7·1	6·9	6·5	6·1	5·7	5·4	5·0	4·7	4·1	3·5
15	7·6	7·4	7·2	6·8	6·4	6·0	5·6	5·3	5·0	4·4	3·8
16	7·8	7·6	7·4	7·0	6·6	6·2	5·9	5·5	5·2	4·6	4·0
17	8·0	7·8	7·6	7·2	6·8	6·4	6·1	5·7	5·4	4·8	4·2
18	8·2	8·0	7·8	7·4	7·0	6·6	6·3	5·9	5·6	5·0	4·4
19	8·3	8·2	8·0	7·5	7·1	6·8	6·4	6·1	5·8	5·1	4·6
20	8·5	8·3	8·1	7·7	7·3	6·9	6·5	6·2	5·9	5·3	4·7
22	8·7	8·6	8·4	7·9	7·5	7·2	6·8	6·5	6·2	5·5	5·0
24	9·0	8·8	8·6	8·2	7·8	7·4	7·0	6·7	6·4	5·8	5·2
26	9·1	9·0	8·8	8·3	7·9	7·6	7·2	6·9	6·6	5·9	5·4
28	9·3	9·1	8·9	8·5	8·1	7·7	7·4	7·0	6·7	6·1	5·5
30	9·5	9·3	9·1	8·7	8·3	7·9	7·5	7·2	6·9	6·3	5·7
35	9·7	9·6	9·4	8·9	8·5	8·2	7·8	7·5	7·2	6·5	6·0
40	10·0	9·8	9·6	9·2	8·8	8·4	8·0	7·7	7·4	6·8	6·2
45	10·1	10·0	9·8	9·4	9·0	8·6	8·2	7·9	7·6	7·0	6·4
50	10·3	10·1	9·9	9·5	9·1	8·7	8·4	8·0	7·7	7·1	6·5
55	10·5	10·3	10·1	9·7	9·3	8·9	8·5	8·2	7·9	7·3	6·7
60	10·6	10·4	10·2	9·8	9·4	9·0	8·6	8·3	8·0	7·4	6·8
65	10·7	10·5	10·3	9·9	9·5	9·1	8·7	8·4	8·1	7·5	6·9
70	10·8	10·6	10·4	10·0	9·6	9·2	8·8	8·5	8·2	7·6	7·0
80	11·0	10·8	10·6	10·2	9·8	9·4	9·0	8·7	8·4	7·8	7·2
90	11·1	10·9	10·8	10·3	9·9	9·6	9·2	8·9	8·5	7·9	7·4

CORRECTION OF A STAR'S ALTITUDE. (*Subtract.*)

Star's Alt.	Height of the Eye, in Feet.										
	26 ft.	28 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	55 ft.	60 ft.	70 ft.	80 ft.
°	′	′	′	′	′	′	′	′	′	′	′
5	15·0	15·2	15·4	15·8	16·3	16·6	17·0	17·4	17·7	18·4	18·9
6	13·6	13·8	14·0	14·4	14·8	15·2	15·6	15·9	16·3	16·9	17·5
7	12·5	12·7	12·9	13·3	13·7	14·1	14·6	14·8	15·1	15·8	16·3
8	11·6	11·8	12·0	12·4	12·8	13·2	13·6	13·9	14·3	14·9	15·4
9	10·9	11·1	11·3	11·7	12·1	12·5	12·9	13·2	13·5	14·2	14·7
10	10·4	10·6	10·7	11·2	11·6	11·9	12·3	12·6	13·0	13·6	14·2
11	9·9	10·1	10·3	10·7	11·1	11·5	11·9	12·2	12·5	13·1	13·7
12	9·5	9·7	9·8	10·3	10·7	11·0	11·4	11·8	12·1	12·7	13·3
13	9·1	9·3	9·5	9·9	10·3	10·7	11·1	11·4	11·7	12·3	12·9
14	8·9	9·0	9·2	9·7	10·1	10·4	10·8	11·1	11·4	12·1	12·6
15	8·6	8·8	8·9	9·4	9·8	10·1	10·5	10·8	11·2	11·8	12·3
16	8·4	8·5	8·7	9·2	9·6	9·9	10·3	10·6	10·9	11·6	12·1
17	8·1	8·3	8·5	8·9	9·3	9·7	10·1	10·4	10·7	11·4	11·9
18	7·9	8·1	8·3	8·8	9·2	9·5	9·9	10·2	10·5	11·2	11·7
19	7·8	8·0	8·2	8·6	9·0	9·4	9·7	10·1	10·4	11·0	11·6
20	7·7	7·8	8·0	8·5	8·9	9·2	9·6	9·9	10·2	10·9	11·4
22	7·4	7·6	7·8	8·2	8·6	9·0	9·3	9·7	10·0	10·6	11·2
24	7·2	7·4	7·5	8·0	8·4	8·7	9·1	9·4	9·8	10·4	10·9
26	7·0	7·2	7·4	7·8	8·2	8·6	8·9	9·3	9·6	10·2	10·8
28	6·8	7·0	7·2	7·6	8·0	8·4	8·8	9·1	9·4	10·0	10·6
30	6·7	6·9	7·0	7·5	7·9	8·2	8·6	8·9	9·3	9·9	10·4
35	6·4	6·6	6·8	7·2	7·6	8·0	8·3	8·7	9·0	9·6	10·2
40	6·2	6·4	6·5	7·0	7·4	7·7	8·1	8·4	8·8	9·4	9·9
45	6·0	6·2	6·4	6·8	7·2	7·6	7·9	8·3	8·6	9·2	9·8
50	5·8	6·0	6·2	6·6	7·0	7·4	7·8	8·1	8·4	9·0	9·6
55	5·7	5·9	6·1	6·5	6·9	7·3	7·6	7·9	8·3	8·9	9·5
60	5·6	5·8	5·9	6·4	6·8	7·1	7·5	7·8	8·2	8·8	9·3
65	5·5	5·7	5·8	6·3	6·7	7·0	7·4	7·7	8·1	8·7	9·2
70	5·4	5·6	5·7	6·2	6·6	6·9	7·3	7·6	8·0	8·6	9·1
80	5·2	5·4	5·6	6·0	6·4	6·8	7·1	7·5	7·8	8·4	9·0
90	5·0	5·2	5·4	5·8	6·2	6·6	6·9	7·3	7·6	8·2	8·8

SUPPLEMENTARY TABLES FOR LOW ALTITUDES.

Correction for Small Altitudes.

Sun's Obs. Altitude.	Height, 40 ft.	2nd Correction, Various Heights.	
		—	*Add* to / *Subt.* from — Alt.
° ′	′	Ft.	′
3 0	−4·9	6	+3·8
3 10	4·4	8	3·4
3 20	3·9	10	3·1
3 30	3·4	12	2·8
3 40	3·0	14	2·5
3 50	2·5	16	2·3
4 0	2·1	18	2·1
4 10	1·8	20	1·8
4 20	1·4	22	1·6
4 30	1·0	24	1·4
4 40	0·8	26	1·2
5 0	0·2	28	1·0
5 20	+0·4	30	0·8
5 40	0·9	32	0·7
6 0	1·3	34	0·5
6 20	1·7	36	0·3
6 40	2·1	38	0·2
7 0	2·4	40	0·0
7 20	2·7	42	−0·2
7 40	3·0	44	0·3
8 0	3·3	46	0·5
8 20	3·5	48	0·6
8 40	3·8	50	0·7
8 50	3·9	52	0·9
9 0	4·0	54	1·0
9 20	4·2	56	1·1
9 40	4·4	60	1·4
10 0	4·6	65	1·7
10 30	4·8	70	2·0
11 0	5·0	75	2·3

Star's Altitude.	Height, 40 ft.	2nd Correction, Various Heights.	
		—	*Add* to / *Subt.* from — Alt.
° ′	′	Ft.	′
3 0	21·1	6	+3·8
3 10	20·6	8	3·4
3 20	20·0	10	3·1
3 30	19·5	12	2·8
3 40	19·1	14	2·5
3 50	18·7	16	2·3
4 0	18·3	18	2·1
4 10	17·9	20	1·8
4 20	17·5	22	1·6
4 30	17·2	24	1·4
4 40	16·9	26	1·2
5 0	16·3	28	1·0
5 20	15·8	30	0·8
5 40	15·3	32	0·7
6 0	14·8	34	0·5
6 20	14·4	36	0·3
6 40	14·1	38	0·2
7 0	13·7	40	0·0
7 20	13·4	42	−0·2
7 40	13·1	44	0·3
8 0	12·8	46	0·5
8 20	12·6	48	0·6
8 40	12·4	50	0·7
8 50	12·3	52	0·9
9 0	12·1	54	1·0
9 20	11·9	56	1·1
9 40	11·7	60	1·4
10 0	11·6	65	1·7
10 30	11·3	70	2·0
11 0	11·1	75	2·3

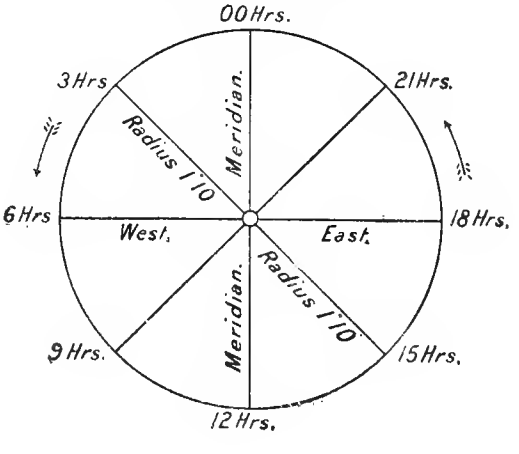
Table G.

STAR POLARIS AZIMUTH TABLE.

✻'s Hr. Angle.	LATITUDES.										✻'s Hr. Angle.
	0°	10°	20°	30°	35°	40°	45°	50°	55°	60°	
	AZIMUTHS.										
H. M.	°	°	°	°	°	°	°	°	°	°	H. M.
0 00	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	12 00
0 20	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·2	0·2	0·2	11 40
0 40	0·2	0·2	0·2	0·2	0·3	0·3	0·3	0·3	0·4	0·4	11 20
1 00	0·3	0·3	0·3	0·4	0·4	0·4	0·4	0·5	0·5	0·6	11 00
1 20	0·4	0·4	0·4	0·5	0·5	0·5	0·6	0·6	0·7	0·8	10 40
1 40	0·5	0·5	0·5	0·6	0·6	0·7	0·7	0·8	0·9	1·0	10 20
2 00	0·6	0·6	0·6	0·7	0·7	0·8	0·8	0·9	1·1	1·2	10 00
2 20	0·7	0·7	0·7	0·8	0·8	0·9	1·0	1·0	1·2	1·4	9 40
2 40	0·8	0·8	0·8	0·9	0·9	1·0	1·1	1·2	1·3	1·6	9 20
3 00	0·8	0·8	0·9	1·0	1·0	1·1	1·2	1·3	1·5	1·7	9 00
3 20	0·9	0·9	1·0	1·0	1·1	1·2	1·3	1·4	1·6	1·8	8 40
3 40	1·0	1·0	1·0	1·1	1·2	1·3	1·4	1·5	1·7	2·0	8 20
4 00	1·0	1·0	1·1	1·2	1·2	1·3	1·5	1·6	1·8	2·1	8 00
4 20	1·1	1·1	1·1	1·2	1·3	1·4	1·5	1·7	1·9	2·2	7 40
4 40	1·1	1·1	1·2	1·3	1·4	1·4	1·6	1·7	1·9	2·2	7 20
5 00	1·1	1·2	1·2	1·3	1·4	1·5	1·6	1·8	2·0	2·3	7 00
5 20	1·2	1·2	1·2	1·3	1·4	1·5	1·6	1·8	2·0	2·3	6 40
5 40	1·2	1·2	1·2	1·4	1·4	1·5	1·7	1·8	2·0	2·3	6 20
6 00	1·2	1·2	1·2	1·4	1·4	1·5	1·7	1·8	2·0	2·4	6 00

For the twelve hours before the meridian passage (*above* the Pole) it is east of north, and for the twelve hours after it is west of north.

DIAGRAM to illustrate the Apparent Motion of Star α Ursæ Minoris (Polaris) round the Pole. Declination of Star in 1910, 88° 49½′ N.; Right Ascension, 1 h. 27 m.



REDUCTION TO THE MERIDIAN TABLE FOR ✳ POLARIS.

AT HOUR-ANGLES FROM UPPER MERIDIAN.

Add Reduction to obtain Meridian Altitude.

Hour-angle.	LATITUDES. 10°	20°	30°	40°	50°	60°	Var. in 10 years / Subt. from Reduction
H. M.	° ′	° ′	° ′	° ′	° ′	° ′	′
0 10	0·1	0·1	0·1	0·1	0·1	0·1	0·0
20	0·3	0·3	0·3	0·3	0·3	0·3	
30	0·6	0·6	0·6	0·6	0·6	0·6	
40	1·1	1·1	1·1	1·1	1·1	1·1	
50	1·7	1·7	1·7	1·7	1·7	1·7	
I 0	2·4	2·4	2·4	2·4	2·5	2·5	0·1
10	3·3	3·3	3·3	3·3	3·3	3·4	0·1
20	4·3	4·3	4·3	4·3	4·4	4·4	0·2
30	5·4	5·4	5·4	5·4	5·5	5·5	0·2
40	6·6	6·6	6·7	6·7	6·7	6·8	0·3
50	8·0	8·0	8·0	8·0	8·1	8·2	0·3
II 0	9·5	9·5	9·5	9·6	9·7	9·8	0·4
10	11·0	11·1	11·2	11·2	11·3	11·4	0·5
20	12·8	12·8	12·9	12·9	13·0	13·2	0·5
30	14·6	14·6	14·7	14·8	14·9	15·0	0·7
40	16·5	16·6	16·7	16·7	16·8	17·0	0·7
50	18·6	18·6	18·7	18·8	18·9	19·1	0·8
III 0	20·7	20·8	20·8	20·9	21·1	21·3	0·9
10	22·9	23·0	23·1	23·2	23·3	23·5	1·0
20	25·2	25·3	25·4	25·5	25·7	25·9	1·1
30	27·6	27·7	27·8	27·9	28·1	28·4	1·2
40	30·1	30·2	30·3	30·4	30·6	30·9	1·3
50	32·7	32·8	32·9	33·0	33·2	33·5	1·4
IV 0	35·3	35·4	35·5	35·7	35·9	36·2	1·5
10	38·0	38·1	38·2	38·4	38·6	38·9	1·6
20	40·8	40·9	41·0	41·2	41·4	41·7	1·7
30	43·6	43·7	43·9	44·0	44·2	44·6	1·9
40	46·5	46·6	46·7	46·9	47·1	47·4	2·0
50	49·4	49·5	49·6	49·8	50·1	50·4	2·1
V 0	52·3	52·4	52·6	52·8	53·0	53·3	2·2
10	55·3	55·4	55·6	55·8	56·0	56·3	2·4
20	58·3	58·5	58·6	58·8	59·0	59·4	2·5
30	I 1·4	I 1·5	I 1·7	I 1·8	I 2·1	I 2·5	2·6
40	I 4·4	I 4·5	I 4·7	I 4·9	I 5·1	I 5·5	2·8
50	I 7·5	I 7·6	I 7·8	I 8·0	I 8·2	I 8·6	2·9
VI 0	I 10·6	I 10·7	I 10·8	I 11·0	I 11·3	I 11·7	3·1

AT HOUR-ANGLES FROM LOWER MERIDIAN.

Subtract Reduction to obtain Meridian Altitude.

Hour-angle.	LATITUDES. 10°	20°	30°	40°	50°	60°
H. M.	° ′	° ′	° ′	° ′	° ′	° ′
0 10	0·1	0·1	0·1	0·1	0·1	0·1
20	0·3	0·3	0·3	0·3	0·3	0·3
30	0·6	0·6	0·6	0·6	0·6	0·6
40	1·1	1·1	1·1	1·1	1·1	1·0
50	1·7	1·7	1·7	1·7	1·7	1·6
I 0	2·4	2·4	2·4	2·4	2·3	2·3
10	3·3	3·2	3·2	3·2	3·2	3·1
20	4·2	4·2	4·2	4·2	4·1	4·1
30	5·3	5·3	5·3	5·3	5·2	5·2
40	6·6	6·6	6·5	6·5	6·4	6·4
50	7·9	7·9	7·9	7·8	7·8	7·7
II 0	9·4	9·4	9·3	9·3	9·2	9·1
10	11·0	10·9	10·9	10·9	10·8	10·7
20	12·7	12·6	12·6	12·5	12·5	12·3
30	14·5	14·5	14·4	14·3	14·2	14·1
40	16·4	16·4	16·3	16·2	16·1	16·0
50	18·5	18·4	18·3	18·2	18·1	18·0
III 0	20·6	20·5	20·4	20·3	20·2	20·0
10	22·8	22·7	22·6	22·5	22·4	22·2
20	25·1	25·0	24·9	24·8	24·7	24·5
30	27·5	27·4	27·3	27·2	27·0	26·8
40	29·9	29·9	29·8	29·6	29·5	29·2
50	32·5	32·4	32·3	32·2	32·0	31·7
IV 0	35·1	35·0	34·9	34·8	34·6	34·3
10	37·8	37·7	37·6	37·4	37·2	36·9
20	40·6	40·5	40·3	40·2	40·0	39·7
30	43·4	43·3	43·1	43·0	42·8	42·4
40	46·2	46·1	46·0	45·8	45·6	45·2
50	49·1	49·0	48·9	48·7	48·5	48·1
V 0	52·1	52·0	51·8	51·6	51·4	51·0
10	55·1	54·9	54·8	54·6	54·4	54·0
20	58·1	58·0	57·8	57·6	57·4	57·0
30	I 1·1	I 1·0	I 0·8	I 0·6	I 0·4	I 0·0
40	I 4·2	I 4·0	I 3·9	I 3·7	I 3·4	I 3·1
50	I 7·2	I 7·1	I 7·0	I 6·8	I 6·5	I 6·1
VI 0	I 10·3	I 10·2	I 10·0	I 9·8	I 9·6	I 9·2

For Azimuths of ✳ Polaris see page 88.

Examples in the Use of the above Table.

Example 1.—On April 2nd, 1914, at 3 h. 30 m. a.m., A.T. Sp. in latitude by D.R. 40° 15′ N., longitude 11° W. Required the approximate altitude of ✳ Polaris for setting the sextant for an observation to obtain the latitude. Height of eye, 40 ft.

Mer. pass of ✳ in 1910 (p. 10)	H. M. 0 44	a.m.	below Pole.
Cor. for 4 years (see p. 6)	+ 2		
Mer. pass. in 1914	0 46	a.m.	
Time at ship	3 30	a.m.	
✳'s Approx. H.A. (below Pole)	2 44	gives reduction	16′·7.

Reduction at 2 40 =	H. M. 16′·2	2	M. × 4	=	+ ′·8
Cor.	+ ·5		7 × ·4 var in 4 years	=	− ·3
True reduction	16′·7				+ ·5

Lat. by D.R.	° ′ 40 15	N.	
P.D. of ✳	−1 9·2		
Mer. alt.	39 5·8		
40 ft. cor. (p. 87)	+ 7·5		
Reduction	39 13·3		
	+ 16·7		
Alt. for sextant	39 30	N.	

✳'s Dl.	° ′ 88 50·8	N.
	90 0·0	
P.D.	1 9·2	N.

Example 2.—On April 2nd, 1914, at 3 h. 35 m. a.m., A.T. Sp. in latitude by D.R. 40° 15′ N., longitude 11° W. Observed altitude of ✳ Polaris was found to be 39° 40′ N. Height of eye, 37 ft. Required the latitude.

Obsd. alt. of ✳	° ′ 39 40	N.	
Eye, 40 ft. (cor. p. 87)	− 7·5		
Reduction	39 32·5		
	− 17·7		
Mer. alt. (below Pole)	39 14·8		
P. dist. in 1914	1 9·2		
Latitude	40 24·0	N.	

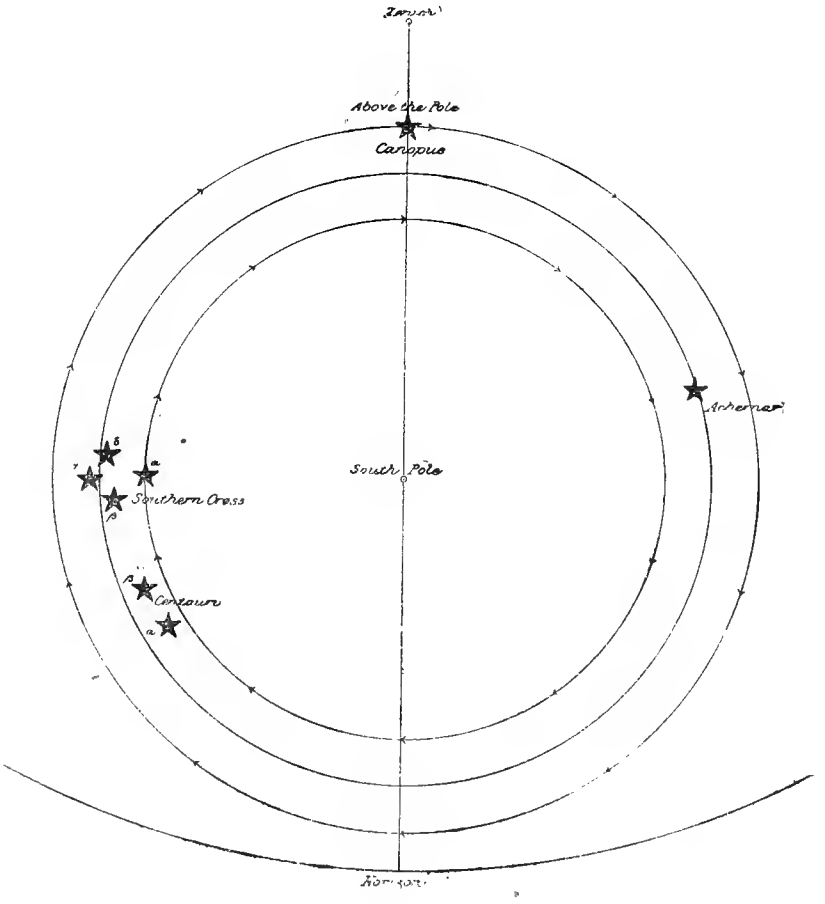
Mer. pass. of ✳ in 1914	H. M. − 0 46	a.m.	
Time of observation	3 35	a.m.	
✳'s Approx. H.A. (below Pole)	2 49	gives reduction	17′·7.

Reduction		18′·0
Cor. for 4 years		−·3
True reduction		17·7

✳'s Sidereal H.A. would be nearly ½ m. greater; this correction, if required, may be made from the acceleration table, (page 86). It will be nearly 1 m. greater for 6 hours.

DIAGRAM TO AID IN FINDING THE POSITION OF SOUTH POLE.

This diagram represents the apparent motion of the bright high-declination stars Achernar, Canopus, and those in the constellations of the Southern Cross and Centaurs to an observer in the latitude of Wellington, New Zealand, in about 41° S. In this latitude none of these stars ever set, and they appear to describe a circle round an imaginary South Pole, with a radius equal to the co-declination of the star. The radius of α Crucis, for instance, is about $27\frac{1}{2}°$. It will be seen from the diagram that β Centauri and Achernar are always on opposite sides of the circle to one another, and that both stars are at nearly equal distances from the Pole; therefore the *approximate* position of the South Pole in the heavens will always be at a point midway between these two stars. When β Centauri is on the meridian above the Pole, Achernar will be close to the meridian below the Pole, or when β Centauri is east of the Pole Achernar will be about the same distance west of the Pole. The Centaurs will appear in almost exactly the same position in the heavens at, say, 6 p.m. on any given day that Achernar was in at 6 a.m. on the same day, or the Centaurs will appear in almost exactly the same position at 6 p.m. on one day that Achernar was in at the same hour of the day six months previously.



GENERAL REMARKS, RULES, AND EXAMPLES.

GENERAL REMARKS ON THE DOUBLE-ALTITUDE AND "SUMNER" PROBLEM.

Many navigators undervalue "Sumner's" method in low latitudes; first, because of the small change of bearing between the usual times of taking the observations, and, secondly, because with a high altitude the circle of altitude or line of position is not to the ;same extent a straight line on the chart. But in practice I have found "Sumner's" method give equally good, or better results in low latitudes than in high, if the observations are taken—or, at any rate, the second one is taken—within an hour of noon, or considerably less than an hour when in the tropics and latitude and declination are of the same name, in which case the "Sumner" or double-altitude method is all the more valuable, as an ex-meridian of the sun by itself would not give a dependable latitude unless the observation was taken within a very few minutes from noon; whereas in high latitudes an ex-meridian will often give a latitude fairly near the truth when the observation has been taken nearly an hour from the meridian. In low latitudes, when observations are taken on both sides of the meridian, 90° change of bearing may often be obtained within an hour, and by the aid of Blackburne's and Westland's ex-meridian tables a good "Sumner" position may be very quickly and accurately obtained from ex-meridian east and west of the meridian. To illustrate this an extreme case is given in this work where the greater altitude is 89°, and the change in bearing in 5 m. amounted to 72°

It is impressed on navigators in these pages by the numerous examples and illustrations following that the lines of position need never be of great length, so that they may always be considered as straight lines even in tropical latitudes. When D.R. latitude is very uncertain, and one of the observations has been taken anywhere near the meridian, it may be worked out as an ex-meridian, plotted on the chart, and combined with another observation taken nearer the prime vertical, which would be worked out for a longitude; or two ex-meridian observations may be be taken and plotted on the chart, examples of which are given on pp. 152 and 153. Reviewers of former editions of this work have been much struck with the simplicity and practical value of this problem. Although the work is simplified and graphically illustrated by plotting the latitudes or longitudes on the chart, the resulting position is readily obtained by calculation without the aid of chart, as shown on pp. 92 to 95.

As most ex-meridian tables and methods of calculation only give a correct latitude when the observation is taken not far from the meridian, a method is given in this work which gives a correct latitude corresponding to a given hour-angle when the sun or other celestial body is several hours away from the meridian. The D.R. latitude is not used in this calculation.

In obtaining the latitude by the double-altitude or "Sumner" method it is best, if the observations are taken on the same side of the meridian, for the same person to observe both; and generally the truest *latitude* will be found if both observations are taken on the *same* side of the meridian, as it is probable that, if for any reason the altitude is observed too high or too low, the same thing will occur in both observations. For the same reason the truest *longitude* will be found from observations taken on *different* sides of the meridian. An example to illustrate this is given on pp. 114 and 115.

REMARKS ON P.M. OBSERVATIONS.

Any one who is in the habit of regularly taking p.m. sights must have noticed the large differences which sometimes occur between a.m. and p.m. observations, which is generally attributed to current, and some men have even been led to believe from this that p.m. sights are not of any value, as though the sun—or, rather, the earth—did not move as uniformly in the afternoon as in the forenoon. The principal *difference* between the result of the two observations is probably generally due to erroneous altitude, especially in rough weather, and sometimes, of course, to erroneous latitude, and the mean of the results from the two observations will generally be nearest the true position. It has often been noticed when there is a heavy sea on that p.m. sights place the longitude a long way to the eastward of the a.m. ones, owing probably to the sun being observed on the top of a wave, and consequently, the altitude being too small, an error which in the morning would place the ship to the westward of the

true position, but in the afternoon just as much to the eastward of it; so that, supposing the ship to be in latitude 48° and the sun to be 30° from meridian at each observation, an error in the latitude of 2′ too little on both occasions would make a *difference* of 12′ of longitude, as may be seen from Table D, on p. 80. Suppose, then, that on the same occasion both observations have been worked with an error of 9′ south of the true latitude; this would make another difference of about 10½′ of longitude, making the p.m. sights 22½′ of longitude to eastward of the a.m. observation, and a slight easterly current in the interval between the two observations might easily make over 30′ difference. Generally, no doubt, one of these errors will in a measure counteract another, but exceptional occasions are almost sure to arise when they will all combine in the same direction.

RULE FOR FINDING THE POSITION OF SHIP FROM TWO OBSERVATIONS BY AID OF TABLES A, B, AND C² WITHOUT THE USE OF CHART.

From Two Chronometer Observations of the Sun.

(1.) Let two chronometer observations be taken at an interval of about an hour and a half or two hours,* and let the first be worked out with the D.R. latitude at the time of observation.

(2.) Let the D.R. latitude and longitude thus obtained be corrected for the run of the ship in the interval between the observations, and let the second observation be worked with the *corrected* latitude. Name these longitudes (1) and (2).

(2.) With the hour-angle, latitude, and declination at each observation, take out the difference of longitude correction from Tables A and B, and name the position-lines corresponding to these corrections according to the instruction under the heading of Table C² (p. 75).

Tables A ± B give the error in longitude due to 1′ of error in latitude.

When both Position-lines go through the Same or Opposite Quadrants.

(3.) The *difference* between the two A and B corrections will give the difference in the resulting longitudes due to 1′ of error in the latitude. (See example on p. 100.)

When both Position-lines go through Adjacent Quadrants.

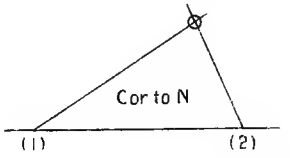
(4.) The *sum* of the two A and B corrections will give the difference in the resulting longitudes due to 1′ of error in the latitude. (See example on pp. 102 and 107.)

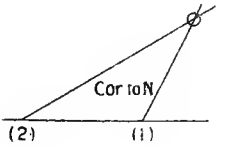
The three elements used in the calculation of time, or longitude, are altitude, latitude, and polar distance. Presuming that the altitude and polar distance are correct, the resulting difference in longitude between the two observations must be due to error in the latitude. The sum or difference of the two A and B corrections give the difference of longitude in the two observations due to 1′ of error in the latitude used in the calculation, and the amount of error in the latitude will therefore be found by a simple proportion sum (see p. 100) from which it will be seen that the error or correction to be applied to the D.R. latitude will be found by dividing the difference between longitudes (1) and (2) by the sum or difference of the A and B corrections. It must be applied to the latitude used in the *last* observation, and to the N. or S. according to whether the position-lines cut one another N. or S. of the D.R. latitude used in the calculation. The true longitude is then found by multiplying either of the A and B corrections by the latitude error, and applying the correction according to the trend of the position-line.

To prevent the possibility of making a mistake in the application of the correction to the latitude, a short horizontal line representing the parallel of D.R. latitude may be drawn with a free hand in the work-book; on this line put down longitudes (1) and (2), and roughly draw the position-lines through each longitude, following the rule for naming the position-lines given on p. 75, under the heading of Table C², also bearing in mind that if the line runs in a north-easterly direction it is equally

* Provided the sun's bearing has changed not less than two points.

true that the line must also run in the opposite direction or south-westerly. No scale for longitude need be used, or protractor for laying down the bearings, but simply put longitude (1) or (2) to the right or left of the other, as they are to the east or west of one another, then draw the general trend of the position-lines through these two longitudes, thus :—





FOR STELLAR OBSERVATIONS.

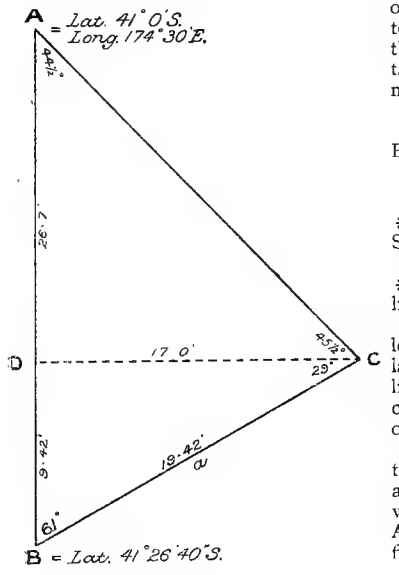
When finding the position of ship from stellar observations, it is best to observe the altitude of *two* stars which have a considerable difference in bearing from one another, and to take both observations within a few minutes of the same time. If the ship has not appreciably changed her position during the interval between the observations, both observations may be worked with the same latitude, and no correction for run need be applied to the first-observation latitude or longitude. Otherwise the same rules apply as for the observations by the sun.

When the ship has appreciably changed her position during the interval between the observations, rules Nos 1 and 2 must be observed as in the sun observations.

FROM EX-MERIDIAN AND CHRONOMETER OBSERVATION COMBINED.

Let two observations be taken with a suitable difference in bearing between them, and let the one nearest the prime vertical be used for a longitude (working it with the D.R. latitude), and the other one for a latitude, using the time deduced from the longitude found by observation in the calculation for latitude: bring both results up to the same instant of time by applying the run in interval between the observations.

Take out the A and B correction for the H.A. and latitude of each observation, and with this enter Table C² (p. 75) and take out the corresponding position-lines. We have then two latitudes and their corresponding position-lines starting from different points on the same meridian. Where these lines cut with one another on a plane chart will be the position of the ship.



From the figure representing these positions and position-lines it will be easy for any one having a knowledge of plane trigonometry to complete the calculation. For the sake of those who have not this knowledge, examples taken from the problems given in this book are now given to illustrate the different cases.

EXAMPLE 1 (p. 109).—*Observations East and West of Meridian.*

With lat. 41° 0′ S., long. by chron. from ✱ Canopus gave 174° 30′ E. and position-line S. 44½° E.

With long. 174° 30′ E., lat. by ex-mer. of ✱ α Centauri gave 41° 26′ 40″ S. and position-line N. 61° E.

For the figure.—From A, in lat. 41° 0′ S. and long. 174° 30′ E., draw a meridian-line to B, in lat. 41° 26′ 40″ S.; from A and B draw the lines S. 44½° E. and N. 61° E. respectively to cut one another at C. From C drop a perp. on A B at D.

In the right-angled triangles A D C and B D C the angles at C will be respectively 45½° and 29°, and therefore the angle at C in the △ A B C will = 74½°. We then have in the △ A B C, A = 44½°, C = 74½°, and A B = 26·7°. First find *a*, then B D, and next C D.

Formula.

$a = A\,B \cdot \sin A \cdot \operatorname{cosec} C$
$B\,D = a \cdot \cos B$
$C\,D = a \cdot \cos C.$

	A B	26·7′	Log	1·4265
	B	44½°	Sin	9·8457
	C	74½°	Cosec	0·0161
	a	19·42′	Log	1·2883
	B	61°	Cos	9·6856
Cor. for lat.	B D	9·42′	Log	0·9739
	a	19·42′	Log	1·2883
	C	29°	Cos	9·9418
Cor. for long.	C D	17·0′	Log	1·2301

Lat. by ex-mer.	41° 26′ 40″ S	Long. by chron.	174° 30′ E
Cor.	9 25 N	Cor.	17 E
Correct lat.	41 17 17 S	Correct long.	174 47 E

FROM TWO EX-MERIDIAN OBSERVATIONS ON DIFFERENT SIDES OF THE MERIDIAN.

Let two observations be taken with a suitable difference in bearing between them, one east and the other west of the meridian, deducing the hour-angle by applying the equation of time and longitude by D.R. Bring both results up to the same instant of time by applying the run in interval between the observations. The latitude from either observation (if worked by a correct method) is the latitude where the circle of altitude of the body observed cuts the meridian used in deducing the time. If both latitudes agree when observations have a considerable difference in bearing between them the longitude must be correct. If the latitudes do not agree the true latitude and longitude may readily be found by plotting on the chart, or by the formula used in preceding example, or by No. 2 method explained below.

METHOD NO. 2.

By Aid of Table giving the Error in Latitude by Ex-meridian due to 4 sec. Error in Time or 1′ of Longitude.

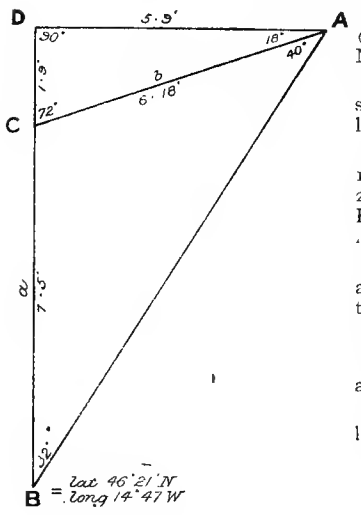
By the aid of the above-named table the double altitude problem may be worked from the meridian, on the same principle as two chronometer observations are worked from a parallel of latitude. If the azimuth is not over 70° (the limit of the table), the problem may be worked from the meridian with either an ex-meridian and chronometer observation combined or from two ex-meridians.

When both observations are on same side of meridian, the *difference* between the two errors in latitude, due to 1′ of error in the longitude, taken from the table, will be the divisor for the two differences of latitude resulting from the two observations, and will give the correction for the longitude used.

When one observation is east and the other west of meridian the error of longitude will be found by dividing the differences of latitude resulting from the two observations by the *sum* of the factors taken from the table. The error in latitude will then be found by multiplying the error in longitude by the correction taken from the table (in preference using the azimuth nearest to the meridian) and applying this to the ex-meridian latitude in the direction of the trend of the position-line, which is always at right angles to the bearing of object.

When the altitude is high and near the meridian the azimuth should be obtained by the time and altitude. This may be done either by Table D or by the rule of sines. (See examples on p. 105.)

EXAMPLE 2 (p. 105).—*Both Observations on Same Side of Meridian.*



With lat. 46° 21′ N., long. by chron. from ⊙ obsn. gave 14° 46′ 55″ W. and position-line N. 32° E.

With long. 14° 46′ 55″ W., lat. by ex-mer. from second ⊙ obsn. gave 46° 28′ 30″ N. and position-line N. 72° E.

For the figure.—From B, in lat. 46° 21′ N. and 14° 47′ W., draw a meridian-line to C = lat. 46° 28·5′ N.; and from B and C draw two lines N. 32° E. and N. 72° E. respectively to cut one another at A. From A drop a perp. on B C produced at D.

We now have in the right-angled triangle A B D angle B = 32° ∴ A = 58°; and in the right-angled triangle A C D angle C = 72° ∴ A = 18°

In the triangle A B C, A will therefore = 40°

Then in the triangle A C B, B = 32°. A = 40°, and $a = 7{\cdot}5'$

First find b, then C D = lat. cor., and A D = long. cor.

Formula.

$b = a \cdot \sin B \cdot \operatorname{cosec} A$
$C\,D = b \cdot \cos C$
$A\,D = b \cdot \cos A.$

a	7·5′	Log	0·8751
B	32°	Sin	9·7242
A	40°	Cosec	0·1919
b	6·18′	Log	0·7912
C	72°	Cos	9·4900
Cor. for lat. C D	1·91′	Log	0·2812

1′ 54·6″

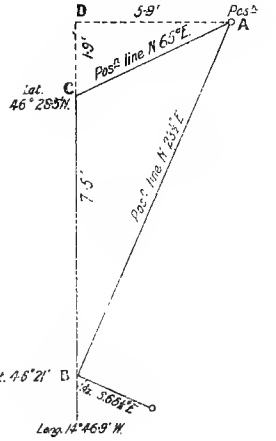
b	6·18′	Log	0·7912
A	18°	Cos	9·9782
Cor. for long. A D	5·88′	Log	0·7694

5′ 52·8″

Lat. by ex-mer.	46	28	30 N
Cor.		1	55 N
Correct lat.	46	30	25 N

Long. by chron.	14	46	55 W
Cor.		5	53 E
Correct long.	14	41	2 W

BY NO. 2 METHOD.



1st obsn. ⊙'s Az. S 66½° E gives (Table M, pp. 150–151) 1′·59 N to Ed.
2nd obsn. ⊙'s Az. S 25° E gives (Table M, pp. 150–151) 0′·32 N to Ed.

Diff. 1′·27

Lat. error	Long.	Diff. lat.	Long. cor.
1′·27	1′	7′·5	5′·9

Lat. (1) 46° 21′·0 N
Lat. (2) 46 28·5 N

1′·27) 7′·5 (5′·9 E × 1′·32 = Lat. cor. 1′·888 N

Lat. by ex-mer. (and obsn.)	46°	28′·5	N	Long.	14° 46′·9 W
Cor.		1·9	N	Cor.	5·9 E
Lat. in	46	30·4	N	Long.	14 41·0 W

EXAMPLE 3 (page 157).—*Two Ex-meridians on Different Sides of the Meridian.*

AT TIME OF 2ND OBSERVATION.

With long. D.R. 2° 35′ 40″ W., lat. by ex-mer. a.m. ⊙ Obsn. 10° 10·4′ S. and position-line for plane chart N. 64·8° W.

With long. D.R. 2° 35′ 40″ W., lat. by ex-mer. p.m. ⊙ Obsn. 9° 55·9′ S. and position-line for plain chart S. 63·7° W.

For the figure.—From A in lat. 10° 10·4′ S. and long. 2° 35·7′ W. draw a meridian line to B at 9° 55·9′ S. and from A and B draw two lines N. 64·8° W. and S. 63·7° W. respectively to cut one another at C. From C drop a perpendicular on A B at D.

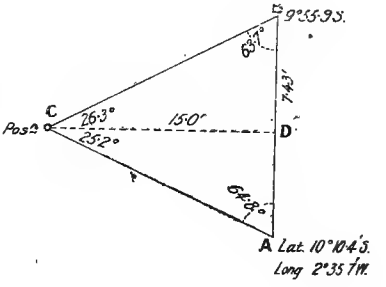
In the right-angled triangles A C D and B C D the angles at C will be respectively 25·2° and 26·3°, and therefore the angle at C in the triangle A B C will equal 51·5° We then have in the triangle A B C, A = 64·8°, C = 51·5°, and A B (diff. lat.) = 14·5′. First find a, then B S = lat. cor., and C D = long. cor.

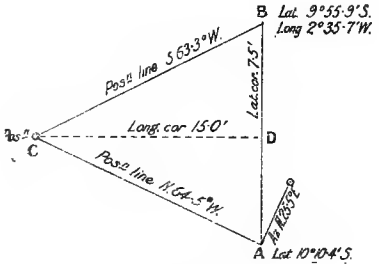
Formula.

a = A B · sin A cosec C
B S = a · cos B
C D = a · cos B C D

A B	14·5′	Log	1·1614				
A	64° 48′	Sin	9·9566				
C	51° 30′	Cosec	0·1066				
a	16·77′	Log	1·2246				1·2246
B	63° 42′	Cos	9·6465	B C D	26° 18′	Cos	9·9525
B D d. lat.	7·43		0·8711	C D long. Cor.	15·04′		1·1771

Lat.	9° 55·9 S	Long.	2° 35·7 W
Cor.	7·4 S	Cor.	15·0 W
Lat. in	10° 3·3 S	Long. in	2° 50·7 W





BY NO. 2 METHOD

A.M. obsn. ⊙'s Az. N 25·5 E gives (Table M, pp. 150–151) ·47 N to Wd.
P.M. obsn. ⊙'s Az. N 26·7 W gives (Table M, pp. 150–151) ·50 S to Wd.

Sum ·97 : 1′ long.

Lat. error	Long.		Diff. lat.		Long. cor.
·97′	1′	:	14·5′	:	15′ W.

Lat. (1)	10° 10·4 S	Lat. (2)	9° 55·9 S	Long.	2° 35·7 W
Lat. (2)	9 55·9	Cor.	7·5 S	Long. cor.	15·0 W
·97)	14·5 (15 × ·5 = 7·5 S	Lat. in	10° 3·4 S	Long. in	2° 50·7 W

REMARKS ON THE POSITION-LINE AND "SUMNER" PROBLEM IN CONNECTION WITH EX-MERIDIANS.

Although most navigators are now fully alive to the value of the position-line in connection with the *longitude by chronometer*, the value of the position-line in connection with the *latitude by ex-meridian* is seldom presented in works of navigation. It is generally supposed that an ex-meridian, if taken within a certain time from noon, will give a correct latitude, and that therefore the ships line of position is anywhere on that parallel of latitude. This, however, is only the case when the ship time (which depends on the longitude) is nearly correct.

The further the object is in bearing away from the meridian the greater will be the error due to an error in the time. (See Table M, pp. 150 to 151.)

The time, however, might be uncertain to 4 or 5 minutes, and yet the ex-meridian observation may be of great value in connection with the position-line, either when near the land by combining this line of bearing with some sounding (see p. 156), or bearing of the land, or by combining it with another astronomical position-line, as in the "Sumner" problem. When the body which is used as an ex-meridian is within the limits of ex-meridian tables, an accurate latitude for a particular meridian may be obtained with very few figures. For cases where the body is outside the usual ex-meridian limits, a formula is here given (pp. 97 to 98) which will give a correct latitude for *any time* from the meridian corresponding to a given hour-angle, which means corresponding to the D.R. longitude of the ship, and these tables give the position-line which cuts this longitude meridian, at that latitude.

It is very generally believed by navigators that an observation taken near the meridian is of no use in connection with the "Sumner" problem. To some extent this is true when the problem is worked by the usually taught methods, and the D.R. latitude is much in error. I have endeavoured to show by the following examples how the ex-meridian problem may be combined with the chronometer observation in the "Sumner" problem: and, if this is done, it matters little how the sun or stars bear when the observations are taken, provided there is a suitable *difference* in bearing (say, 3 points or more) between the two position-lines.

The latest ex-meridian tables by Blackburne and Westland enable the navigator to very readily obtain his position from two ex-meridians or by an ex-meridian and chronometer observation, which may be worked as a double altitude, or plotted on the chart, just as accurately and even more rapidly than it could be done from two chronometer observations.

When observations are taken at the best possible time—shortly before sunrise and after sunset, when probably only three or four of the brightest stars are visible—we can not expect always to get two stars sufficiently far from the meridian and prime vertical as is considered by some necessary (*vide* "Wrinkles," 9th Ed., p. 514) for a satisfactory double altitude to be worked on the "Sumner" principle. However, if advantage is taken of the methods shown in the following examples, it will be seen how little this matters. The only necessary condition of importance to insure good results is that the stars should be sufficiently far apart in bearing to give a good cut; and if one observation be near the prime vertical, and the other one near the meridian, the writer would say so much the better, rather than that this should be looked upon as an objection.

The following figures give the cases for any time from the meridian, when from a given hour-angle the latitude is required to be found.

LATITUDE BY EX-MERIDIAN WHEN OUTSIDE ORDINARY LIMITS.

CASE No. 1.—Object above the Pole, Angle at Z (= Bearing of Object) more than 90° reckoned from Observer's Pole.

In the spherical triangle Z P D, let Z P = co-lat., Z D = co-alt, and P D = Polar Dist.

Given Z D, P D, and angle at P: to find P Z = co-lat.

From D drop a perpendicular on the meridian at M, then in the right-angled spher. triangle P M D we have P D and angle at P to find P M = arc (1).

Formula.—Cos P = tan (1) · cot P D ∴ tan (1) = cos P · tan P D.

Next find Z M = arc (2).

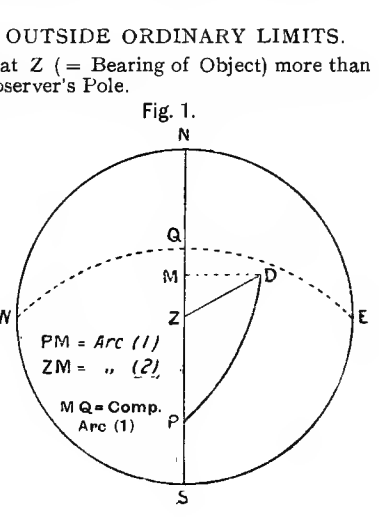
In the spher. triangle P M D, cos P D = cos (1) · cos M D.

In the spher. triangle Z M D, cos Z D = cos (2) · cos M D.

$$\therefore \frac{\text{Cos (2)}}{\text{Cos (1)}} = \frac{\text{Cos Z D}}{\text{Cos P D}} \therefore \left.\begin{array}{l}\text{cos (2) = cos (1)} \cdot \\ \text{cos Z D} \cdot \text{sec P D.}\end{array}\right\}$$

P Z (co-lat. = arc (1) − arc (2).

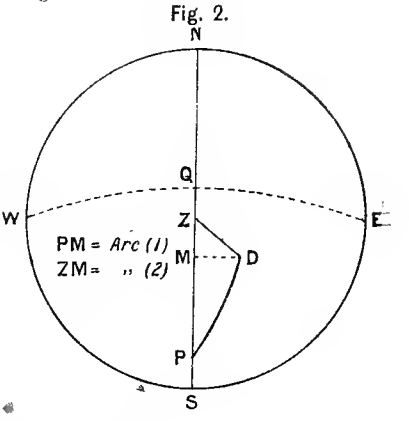
Fig. 1.



CASE No. 2.—Exceptional Case—Angle at Z less than 90°.

Same formula as in previous case, but P Z (co-lat.) = arc (1) + arc (2).

Fig. 2.

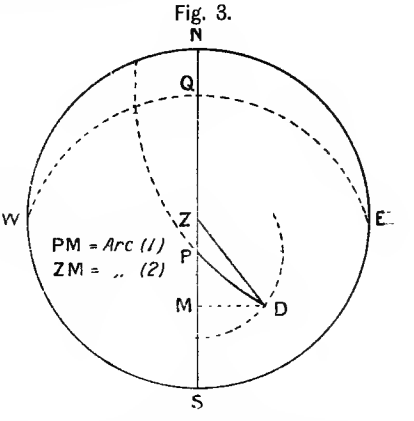


CASE No. 3.—Object below the Pole.

In the spher. triangle P M D, angle at P = supplement of hour-angle. Then follow the same formula as in Case No. 1

P Z (co-lat.) = arc (2) − arc (1).

Fig. 3.



By using the complements of P D and Z D, and comp. of P M for arc (1) when object is above the Pole, or comp. of Z M when object is below the Pole, the formula may be arranged as follows, and the rule as below applied :—

OBJECT ABOVE THE POLE.

Cot arc (1) = cos H.A. × cot decl.
Cos arc (2) = cosec decl. × sin arc (1) × sin alt.
Name arc (1) *same* as decl.
Name arc (2) *contrary* to bearing of object—*i.e.*, N. or S. of the prime vertical.
Add like and subtract unlike names. Sum or diff. of arc (1) and arc (2) = latitude.

OBJECT BELOW THE POLE.

Tan arc (1) = cos suppt. of H.A. × cot decl.
Sin arc (2) = cosec decl. × cos arc (1) × sin alt.
Name both arc (1) and arc (2) *same* as the decl.
Latitude = sum of arc (1) and arc (2) always named *same* as the decl.

NOTE.– It is not advisable to use the formulæ here given when other methods can be used, if the declination of object is within 3° or 4° N. or S. decl. If it is then used, six-figure logarithms should be taken out, and the corrections made for odd seconds of arc.

Examples in the use of these formulæ are given in the problems following.

FORMULÆ FOR EX-MERIDIANS.

Worked-out Examples to illustrate each Case.

As some have been puzzled in trying to follow the ex-meridian formulæ from the figures here given when latitude and declination are of contrary names, owing to P D and P M being over 90°, the reader is reminded that to take out the tan and sec of an arc if over 90° he must take out the cotan and cosec of amount in excess of 90°.

If the *rule* is followed independently of the figure this confusion will be avoided, as decl. and alt. are used, instead of P.D. and Z.D.

Examples of each case, following either figure or rule, are here fully worked out which can be easily followed.

Case No. 1.—Hour-angle 2 h. 17 m. 10 s., Lat. S., Decl. 23° N., and Altitude 16° N. Required the latitude.

Formula from the Figure.				Formula deduced as per Rule.			
	H. M. S.			H. M. S.			
H.A.	2 17 10	Cos 9·91707		H.A. 2 17 10	Cos 9·91707		
P D	113°	Tan 0·37215	Sec 0·40812	Dl. 23° N	Cot 0·37215	Cosec	0·40812
P M	117° 11½′	Tan 0·28922	Cos 9·65989	Arc (1) 27° 11½′ N	Cot 0·28922	Sin	9·65989
		Z D 74°	Cos 9·44034		Alt. 16°	Sin	9·44034
Z M	71 11½		Cos 9·50835	Arc (2) 71 11½ S		Cos	9·50835
Co-lat. P Z	46 0			Lat. 44 0 S			
Lat.	44 0 S						

Case No. 2.—Hour-angle 1 h. 38 m. 12 s., Lat. N., Decl. 40° N., and Altitude 61° N. Required the latitude.

	H. M. S.			H. M. S.			
H.A.	1 38 12	Cos 9·95885		H.A. 1 38 12	Cos 9·95885		
P D	50°	Tan 0·07619	Sec 0·19193	Decl. 40°	Cot 0·07619	Cosec	0·19193
P M	47° 18½′	Tan 0·03504	Cos 9·83126	Arc (1) 42° 41½ N	Cot 0·03504	Sin	9·83126
		Z D 29°	Cos 9·94182		Alt. 61°	Sin	9·94182
Z M	22 41½		Cos 9·96501	Arc (2) 22 41½ S		Cos	9·96501
Co-lat. P Z	70 0			Lat. 20 0 N			
Lat.	20 0 N						

Case No. 3.—Hour-angle 9 h. 23 m. 47 s., Lat. S., Decl. 62° 34′ S., and Altitude 22° S. Required the latitude.

	H. M. S.			H. M. S.			
H.A.	9 23 47			H.A. 9 23 47			
	12 0 0			12 0 0			
Supt.	2 36 13	Cos 9·89017		Supt. 2 36 13	Cos 9·89017		
P D	27° 26′	Tan 9·71524	Sec 0·05181	Decl. 62° 34′ S	Cot 9·71524	Cosec	0·05181
P M	21° 57¼′	Tan 9·60541	Cos 9·96731	Arc (1) 21° 57¼′ S	Tan 9·60541	Cos	9·96731
		Z D 68°	Cos 9·57357		Alt. 22°	Sin	9·57357
Z M	66 57¼		Cos 9·59269	(Comp) Arc (2) 23 2¾ S		Sin	9·59269
Co-lat. P Z	45 0			Lat. 45 0 S			
Lat.	45 0 S						

The accuracy of this method may easily be proved by reversing the process, and finding the hour-angle from the latitude, declination, and altitude given.

Case No. 3 is especially useful, as with high-declination stars the latitude will generally be fairly correct, even when the time is in error a couple of minutes and the body observed is an hour or more from the meridian below the Pole. For instance, in the latitudes of last example, an ex-meridian of * α Crucis with hour-angle 11 h., or 1 h. from meridian below the Pole, and 2 m. of error in the time used, would only cause an error of 2½′ in the resulting latitude.

DOUBLE-ALTITUDE POSITION BY TWO SUN OBSERVATIONS.

1902.—March 29th, p.m., the following observations were taken in the artificial horizon, at 50 Hawker Street Wellington:—

	D. H. M. S.		° ′ ″
M. T. G. by chron.	28 13 17 31	Obsd. alt. of ☉	89 0 30
" "	28 15 51 18	" "	52 5 10

Required the true bearing of the sun at each observation, and the position of place, assuming latitude to be 41° 0′ S Index error of sextant + 1′ 23″; ther. 70°; bar. 30·0in.

1ST OBSERVATION.

	D. H. M. S.		″ H.
M T.G.	28 13 17 31	Dl. var.	58·52 × 10·71
Before noon, 29th	10 42 29		° ′ ″
		Cor.	− 10 26·7
	S. H.	Dl., 29th	3 7 20·7 N
Eq. T. var.	0·767 × 10·7		
		Cor. Dl.	2 56 54 N
	M. S.		
Cor.	+ 8·2	P. D.	92 56 54
Eq. T., 29th	5 5·1		
Cor. Eq. T.	5 13·3 + A. T.		

	° ′ ″		
Obsd. alt. ☉	89 0 30		
I. E.	+ 1 23		
	2) 89 1 53		
App. alt.	44 30 56·5		
Ref. and par.	− 50·5		
	44 30 6		
Semi-d.	− 16 2		
T. alt.	44 14 4		
Lat.	41 0 0	Sec	0·122220
P. D.	92 56 54	Cosec	0·000575
	178 10 58		
S	89 5 29	Cos	8·200237
S − A	44 51 25	Sin	9·848398
H.A.	0h 55m 58·6s	Sin²	8·171430
Eq. T.	+ 5 13·3		
M. T. place	29 1 1 11·9	A	3·49 N
M. T. G.	28 13 17 31·0	B	·22 N
Long. in T.	11 43 40·9	Cor.	3·71 N
Long. (1)	175° 55′ 13″ E	C gives Az.	N 19·7° W

T. C² gives Pos.-line for plane chart N 75° E

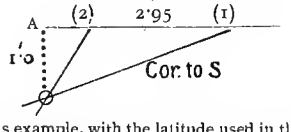
2ND OBSERVATION.

	D. H. M. S.		″ H.
M.T.G.	28 15 51 18	Dl. var.	58·51 × 8·15
Before noon	8 8 42 = 8·15 hr.		° ′ ″
		Cor.	− 7 56·8
	S. H.	Dl., 29th	3 7 20·7 N
Eq. T. var.	0·767 × 8·1		
		Cor. Dl.	2 59 24 N
	M. S.		
Cor.	+ 6·2	P. D.	92 59 24
Eq. T., 29th	5 5·1		
Cor. Eq. T.	5 11·3		

	° ′ ″		
Obsd. alt. ☉	52 5 10		
I. E.	+ 1 23		
	2) 52 6 33		
App. alt.	26 3 16·5		
Ref. and par.	− 1 44		
	26 1 32·5		
Semi-d.	− 16 2·5		
T. alt.	25 45 30		
Lat.	41 0 0	Sec	0·122220
P. D.	92 59 24	Cosec	0·000591
	159 44 54		
S	79 52 27	Cos	9·243045
S − A	54 6 57	Sin	9·908594
H.A.	3h 26m 8·8s	Sin²	9·276450
Eq. T.	+ 5 11·3		
M. T. place	29 3 31 20·1	A	·69 N
M. T. G.	28 15 51 18·0	B	·07 N
Long. in T.	11 40 2·1	Cor.	·76 N
Long. (2)	175 0 31 E	C gives Az.	N 60·2° W
Long. (1)	175 55 13 E		
Diff. long.	54 42 = 54·7′	Pos.-line T. C²	N 37·2° E

Long. (1) cor. = 3·71 N to E (1) to A
Long. (2) " ·76 N to E (2) to A } in Fig.

D. long. 2·95 : d. long. 54·7 :: lat. 1′ : lat. cor. 18·5



	° ′ ″		° ′ ″
Lat. used	41 0 0 S	Long. (2)	175 0 31 E
Cor.	18 30 S	18·5′ × ·76′ =	14 4 W
Lat. in	41 18 30 S	Long. in	174 46 27 E

In this example, with the latitude used in the calculation 17½′ in error, the resulting latitude is 1′ in error. This is due to the sun's azimuth differing nearly 2° at the position corresponding to the hour-angle found with 41° lat. from that of the true hour-angle and latitude. If the position had been worked in the usual way as given in the Board of Trade examinations with two latitudes, say, 17′ in error on each side of the true latitude, the resulting latitude would have been just 2′ north of that here found, or 1′ north of the true latitude. When the hour-angle is small, and the two latitudes used on each side of the true latitude are far apart, the resulting position-line always places the ship on the Equatorial side of the true position-line or circle of altitude. When the problem is worked with the D.R. latitude, and a position-line at right angles to the bearing of the object observed, the resulting position-line will place the ship on the Polar side of the true line of position; an error of 30′ in the D.R. latitude in either case will sometimes make 2′ to 3′ error in the latitude. When one of the hour-angles is not far from the meridian, as in this case, the problem as worked on the following page will give a more accurate position, and the work is not longer.

These observations when reworked on the same principle, when using a latitude near the the truth, give the latitude of position within 0·1′ of the truth. Several observations were taken at the same time, and all the resulting latitudes agreed within a few seconds of one another.

For position of place plotted on the chart, see chartlet on next page.

DOUBLE-ALTITUDE POSITION BY TWO SUN OBSERVATIONS

(Combining Chron. Long. Observation with an Ex-meridian).

1902.—March 29th, p.m. In assumed latitude 41° 0′ S. the true altitude of sun's centre was 44° 14′ 4″ when a chronometer showed M. T. G. 28 d. 13 h. 17 m. 31 s.; and again on the same afternoon the true altitude of sun's centre was found to be 25° 45′ 30″ when a chronometer showed M. T. G. 28 d. 15 h. 51 m. 18 s. Required the position of place by projection on the chart.

1st Obsn. West of Meridian.

	d. h. m. s.				
M. T. Greenwich	28 13 17 31				
Long. in T. by 2nd obsn.	+ 11 40 2 E				
M. T. place	29 0 57 33				
Eq. T.	− 5 13				
⊙'s H.A.	0 52 20	Cos 9·988578			
⊙'s Dl.	2°56′54″ N	Cot 11·288163	Cosec 11·288738		
Arc (1)	° ′ ″ 3 1 36 N	Cot 11·276741	Sin	8·722640	
	True alt. 44° 14′ 4″		Sin	9·843604	
Arc (2)	44 15 56 S		Cos	9·854982	
Latitude	41° 14′ 20″ S				

0 h. 52 m.

Lat.	41½° S	A	3·80 N
Dl.	3° N	B	·23 N
Pos.-line from Table C2	N 76° E		4·03 N

2nd Obsn. West of Meridian.

	° ′ ″		
T. alt.	25 45 30		
Lat.	41 0 0	sec	
P. D.	92 59 24	cosec	
	159 44 54		
S	79 52 27	cos	
S − A	54 6 57	sin	
Sec	0·122220		
Cosec	0·000591		
Cos	9·245045		
Sin	9·908594		
Sin²	9·276450		

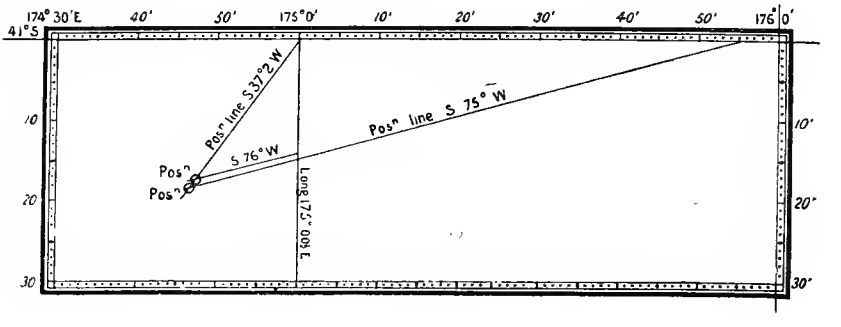
	H. M. S.
H.A. = A.T. place	3 26 8·8
Eq. T.	+ 5 11·3
M. T. place	29 3 31 20·1
M. T. G.	28 15 51 18
Long. in T.	11 40 2·1
Longitude	175° 0′ 31″ E

Position by Chart.

	° ′
Lat.	41 17½ S
Long.	174 47 E

H.A. 3 h. 26 m.

Lat.	41° S	A	·69 N
Dl.	3° N	B	·07 N
Pos. line from Table C2	N 37·2° E		·76 N



Position by two chron. observations = Lat 41° 18½′ S.
(see previous page) Long. 174 46½ E.

The following example is taken from Captain Thompson's excellent book, "Navigation Simplified," which, I presume, is now in the hands of nearly all those navigators who desire to obtain the highest certificates. This example is taken as the work is there given in detail, with the plotting on the chart, so that the reader can compare the working, and see for himself the saving in figures, while maintaining equal, if not greater, accuracy by using the A and B Tables.

POSITION BY DOUBLE ALTITUDE OF SUN.

1900.—July 2nd, at about 6 h. 50 m. a.m., and again at 11 a.m., from the following observations:—

Mean Time at Greenwich by Chron.	True Altitude of the Sun's Centre.
D. H. M. S.	° ′ ″
1 7 43 12	25 51 6
1 11 57 36	69 50 25

Find the true bearing of the sun when the first altitude was observed, and the position of the ship when the second altitude was taken, assuming the ship to be between latitudes 49° 50′ N. and 50° 20′ N. The ship's course and distance between the observations was N. 67° W., dist. 30 miles.

1st obsn. ⊙'s Cor. Dl. = 23 6 49 N (° ′ ″) Cor. Eq. T. 3 35 + A. T. (M. S.)
90 0 0
N. P. D. 66 53 11

2nd obsn. ⊙'s Cor. Dl. = 23 6 7 N (° ′ ″) Cor. Eq. T. 3 36·4 (M. S.)
90 0 0
N. P. D. 66 53 53

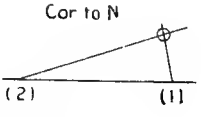
Run between observations, N 67° W 30 m. = 11·7′ N 27·6′ W = 43′ d. long.

Lat. (1) 49 50 0 N (° ′ ″)
Run. d. lat. 11 42 N

	1st Obsn. (° ′ ″)		2nd Obsn. (° ′ ″)	
A	25 51 6		60 50 25	
L	49 50 0	Sec 0·190431	50 1 42	Sec 0·192188
P	66 53 11	Cosec 0·036340	66 53 53	Cosec 0·036302
	142 34 17		177 46 0	
S	71 17 8·5	Cos 9·506301	88 53 0	Cos 8·289773
S − A	45 26 2·5	Sin 9·852750	28 2 35	Sin 9·672223
	H. M. S.		H. M. S.	
	24 0 0		24 0 0	
H. A. east	− 5 6 58	Sin² 9·585822	− 0 57 13·5	Sin² 8·190486
A. T. ship	18 53 2		23 2 46·5	
Eq. T.	+ 3 35	A ′28 S	+ 3 36·5	A 4·68 S
		B ·44 N		B 1·72 N
M. T. S.	18 56 37		23 6 23	
M. T. G.	7 43 12	C ·16 N gives Az. N 84° E	11 57 36	T. C 2·96 S
Long. in T.	11 13 25	Pos.-line for plane chart, Table C², gives N 9·1° W	Long. in T. 11 8 47	Posn.-line for plane chart, S 71·3° W. See Table C²
	° ′ ″			
Long.	168 21 15 E			
Run d. long.	43 0 W			
Long. (1)	167 38 15 E		Long. (2) 167 11 45 E	2·96 S to W and N to E
Cor ·16′ × 8·5′	1 22 W		Long. (1) 167 38 15 E	·16 N to W
Long. in	167 36 53 E at time of 2nd observation.		D. long. 26′ 30″	3·12 sum of A and B cor.

d. long.	d. long.	lat.	lat.
3·12′	: 26·5′	:: 1′	8·5′ cor.

Lat. at 2nd obsn. 50 1 42 N (° ′ ″)
Cor. 8 30 N
Lat. in 50 10 12 N



For position of ship when plotted on the chart, see chartlet on next page.

DOUBLE ALTITUDE OF THE SUN

(Combining Chron. Long. Observation with an Ex-meridian).

1900.—2nd July, at about 6 h. 50 m. a.m., and again at 11 a.m., from the following observations :—

Mean Time at Greenwich by Chron.	True Altitude of the Sun's Centre.
D. H. M. S.	° ′ ″
1 7 43 12	25 51 6
1 11 57 36	60 50 25

Find the true bearing of the sun when first altitude was observed, and the position of the ship when the second altitude was taken, assuming the ship to be between latitudes 49° 50′ N. and 50° 20′ N. The ship's course and distance between the observations was N. 67° W., dist. 30 miles.

1st obsn. ⊙'s Cor. Dl. = ° ′ ″ 26 6 49 N + 90 0 0 = N. P. D. 66 53 11 — Cor. Eq. T. = M. S. 3 35 + A.T.

2nd obsn. ⊙'s Cor. Dl. = ° ′ ″ 23 6 7 N + 90 0 0 = N. P. D. 66 53 53 — Cor. Eq. T. = M. S. 3 36·4 + A.T.

Run between observations, N 67° W 30 m. = 27·6 m. dep. = 43′ W d. long.

1st Obsn.

A	° ′ ″ 25 51 6		
L	49 50 0	Sec	0·190431
P	66 53 11	Cosec	0·036340
	142 34 17		
S	71 17 8·5	Cos	9·506301
S − A	45 26 2·5	Sine	9·852750
	H. M. S. 24 0 0		
H.A. east	− 5 6 58	Sin²	9·585822
A. T. ship	18 53 2		
Eq. T.	+ 3 35		
M. T. ship	18 56 37		
M. T. G.	7 43 12		
Long. in T.	11 13 25		
Longitude	168° 21′ 15″ E		
Run d. long	43 0 W		
	H. M. S.		
Long. (2)	167 38 15 E = 11 10 33		
M. T. G.	+ 11 57 36		
M. T. ship	23 8 9		

H.A. 5 h. 8 m E; Lat. 50° N } A ·28 S; Dl. 23° N } B ·55 N

Cor. Table C ·16 N gives Az. N 84·1° E and Pos.-line for plane chart, Table C², N 9° W

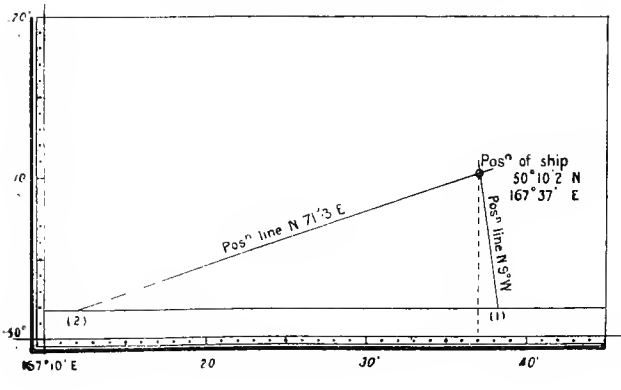
2nd Obsn.

M. T. ship	H. M. S. 23 8 9 (see M.T. ship, 1st obsn.)			
Eq. T.	− 3 36			
A. T. ship	23 4 33			
	24 0 0			
H. A.	0 55 27	Cos	9·987163	
Dl.	23° 6′ 7″	Cot	0·370003	Cosec 0·406306
Arc (1)	23° 43′ 10″ N	Cot	0·357166	Sin 9·604595
		T. alt. 60° 50′ 25″		Sin 9·941146
Arc (2)	26 27 22 N			Cos 9·951957
Lat.	50° 10′ 32″ N			

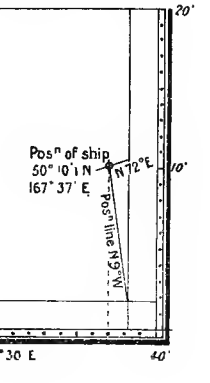
H.A. 0 h 56 m E; Lat. 50 N } A 4·78 S; Dl. 23 N } B 1·75 N

Cor. T. C. 3·03 S gives Az. S 27·4° E = Pos.-line for plane chart, Table C², S 71·7° W and N 71·7° E

Chartlet for Problem on page 102.



For above Problem.



With the desire to show the especial utility of these tables for obtaining accuracy of position and conciseness in work, and the superiority of the method here advocated over the method still employed in the Board of Trade Examinations of Masters and Mates, for the "Sumner" problem, the following example is given and plotted on the chart by both methods. For the sake of better illustrating the possible error due to the old method, a wider range of latitude has been taken than is usually given in the examination papers, though, considering the high speed of some of the present-day steamers, the range is not excessive, as the run in interval itself might often amount to over 1° of latitude

"SUMNER" PROBLEM AS GIVEN IN THE B. OF T. EXAMINATIONS.

1898.—On 20th June, a.m., at ship, at sea, and uncertain of my ship's position: when a chronometer indicated M. T. Green. 19 d. 22 h. 30 m. the true altitude of sun's centre was 52° 9′; and again, a.m. on same day, when chronometer indicated 20 d. 0 h. 16 m. the true altitude of sun's centre was 65° 18′, the ship having made 23 miles on a true N. 24° E. course during the interval between the observations. Required the line of position and true bearing of the sun at time of 1st observation; and the position of the ship when 2nd observation was taken, assuming latitudes 46° N. and 47° N.

1st obsn.		D. H. M. S.	2nd obsn.	D. H. M. S.	Decl.	° ′
	M. T. Green.	19 22 30 0		20 0 16 0		23 27 N
	Eq. of time	− 1 16·7		− 1 17·7		90 0
	A. T. Green.	19 22 28 43·3	A. T. G.	20 0 14 42·3	P. D.	66 33

1st Observation.

	° ′			° ′		
A	52 9			52 9		
L	46 0	Sec	0·158229	47 0	Sec	0·166217
P	66 33	Cosec	0·037438	66 33	Cosec	0·037438
	164 42			165 42		
S	82 21	Cos	9·124248	82 51	Cos	9·095056
S − A	30 12	Sin	9·701585	30 42	Sin	9·708032
	D. H. M. S.			D. H. M. S.		
H. A.	2 31 18·8 E	Sin²	9·021500	2 28 40·3 E	Sin²	9·006743
A. T. ship	19 21 28 41·2			19 21 31 19·7		
A. T. G.	19 22 28 43·3			19 22 28 43·3		
Long. in T.	1 0 2·1			0 57 23·6		
Long. A	15° 0′ 31″ W			14° 20′ 54″ W	Long. B	

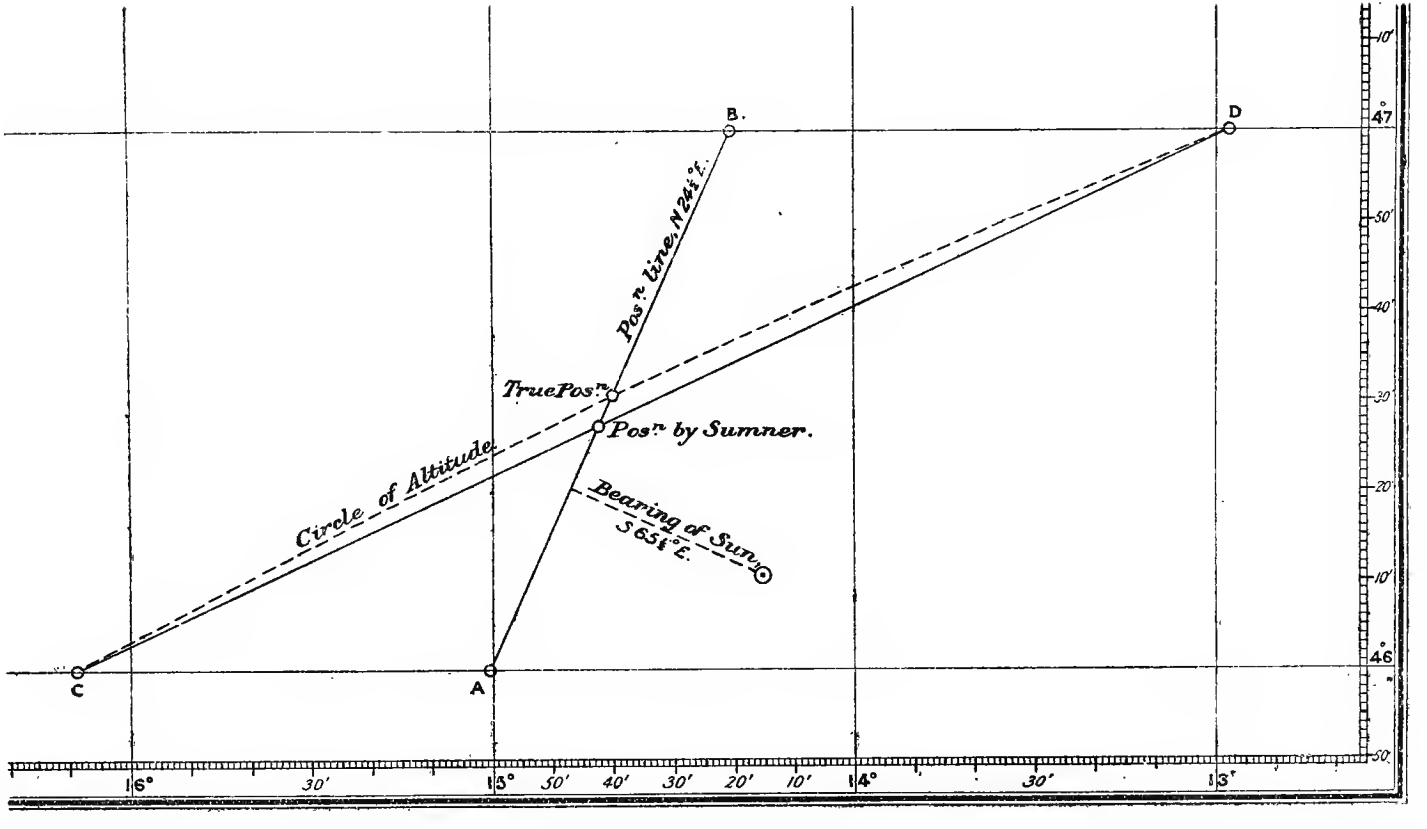
2nd Observation.

	° ′			° ′		
A	65 18			65 18		
L	46 0	Sec	0·158229	47 0	Sec	0·166217
P	66 33	Cosec	0·037438	66 33	Cosec	0·037438
	177 51			178 51		
S	88 55½	Cos	8·273260	89 25½	Cos	8·001538
S − A	23 37½	Sin	9·602872	24 7½	Sin	9·611435
	D. H. M. S.			D. H. M. S.		
H. A.	0 49 53·1 E	Sin²	8·071799	0 37 9·2 E	Sin²	7·816628
A. T. ship	19 23 10 6·9			19 23 22 50·8		
A. T. G.	19 24 14 42·3			19 24 14 42·3		
Long. in T.	1 4 35·4			0 51 51·5		
Long. C	16° 8′ 51″ W			12° 57′ 52″ W	Long. D	

Line of position N 24½° E
Sun's bearing S 65½° E

Position at 2nd obsn.—Lat. 46° 27′ N
Long. 14° 43′ W

True posn.—Lat. 46° 30′ 20″ N
Long. 14° 41′ 0″ W


B.
D
Pos.r line, N 24½° E.
True Pos.n
Pos.n by Sumner.
Circle of Altitude.
Bearing of Sun
S 65½° E.
C
A
47°
46°
10'
50'
40'
30'
20'
10'
50'
16°
30'
13°
50'
40'
30'
20'
10'
14°
30'
13°

SUMNER PROBLEM FACILITATED BY A, B, AND C² TABLES.

1898.—On 20th June, a.m., at ship, at sea, and uncertain of my ship's position: when a chronometer indicated M. T. Green. 19 d. 22 h. 30 m. the true altitude of sun's centre was 52° 9′; and again on same day when chronometer indicated 20 d. 0 h. 16 m. the true altitude of sun's centre was 65° 18′, the ship having made 23 miles on a true N. 24° E. course during the interval between the observations. Required the line of position and true bearing of the sun at time of 1st observation; and the position of the ship when 2nd observation was taken, assuming D.R. latitude to be 46° N. when 1st observation was taken.

1ST OBSN.

	D.	H.	M.	S.
M. T. Green.	19	22	30	0
Eq. of time	—		1	16·7
A. T. Green	19	22	28	43·3

Decl. 23° 27′ N = P. D. 66° 33′

	°	′		
A	52	9		
L	46	0	Sec	0·158229
P	66	33	Cosec	0·037438
	164	42		
S	82	21	Cos	9·124248
S − A	30	12	Sin	9·701585

	D.	H.	M.	S.		
H.A.		2	31	18·8	Sin²	9·021500

A.T. ship	19 21 28 41·2	H.A.	2 h. 32 m.	A 1·33 S
A.T.G.	19 22 28 43·3	Lat.	46° N	B 0·71 N
Long. in T.	1 0 2·1	Dl.	23½° N	C 0·62 S gives Az. S 66°·7 E.
Long.	15° 0′ 31″ W			
Run, d. long.	13 36 E			C² gives Posn.-line for plane chart N 31·8° E
Long. (1)	14 46 55 W			
Long. in T.	0h 59m 7·7s			Lat. 46° 21′ N and Posn.-line N 32° E

2ND OBSN.

	D.	H.	M.	S.
M.T.G.	20	0	16	0
Eq. of time	—		1	17·7
A.T. Green.		0	14	42·3
Long. (1)		— 0	59	7·7 W
A.T. ship	19	23	15	34·6
		24	0	0
H.A.		0	44	25·4

Run N 24° E 23 = 21′ N 9′·4 E = 13′·6 d. long.
Lat. (1) 46° 0 N

Lat. D.R. 46 21 N at time of 2nd obsn.

FOR AZ. BY TABLE D.

	M.	°	
Az. (H.A.)	44·4 = 11·1	}	(p. 81)
Lat. (decl.)	23·5° N	}	M = 22·6

Lat. 65·3° } (p. 82)
M. 22·6 } gives Az. 25°, which gives (p. 49) A & B 3·10′.
A & B 3·10′ gives (p. 75) posn.-line for Plane Chart N. 72° E.

Position from chart.—Lat. 46° 30′·5 N
Long. 14 41·0 W

LAT. BY EX-MER. TABLE No. 3.

				°	′
Decl.	23° 27′ N	}	Arc. cor.	+	23·8
H.A.	44·4m	}	Dec.	23	27·0 N
Arc (1)	.			23	50·8 N

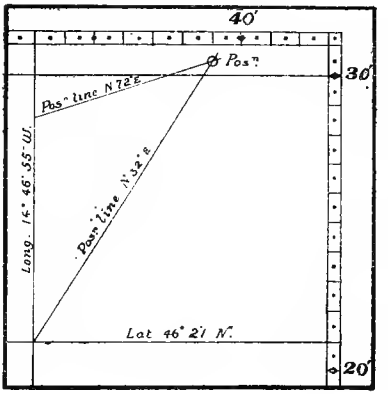
				°	′
Az.	25	0	Arc cor.	− 2	4·2
Alt.	65	18 S	Z D	24	42·0 N
Z D	24	42 N	Arc (2)	22	37·8 N
			„ (1)	23	50·8 N
			Lat.	46	28·6 N

RULE FOR FINDING LATITUDE BY EX-MERIDIAN TABLE No. 3 (ABOVE POLE OBSERVATION).

With declination at side and hour-angle from top take out arc reduction.
Add this reduction to the declination for arc (1).
Name it the same as declination.

With altitude at the side and azimuth from the top take out 2nd arc reduction.
Subtract the reduction from Z D for arc (2).
Name arc (2) contrary to bearing of object.

Latitude = arc (1) ± arc (2).
+ when arcs are of like names.
− when arcs are of unlike names.



NOTE.—This problem worked by the old method (which is still used in the Board of Trade examinations) would give a result 3½′ in error in the latitude and 2′ in error in the longitude. (See page 104.)

EXAMPLE TO SHOW METHOD OF FINDING THE TRUE LINE OF POSITION OR CIRCLE OF ALTITUDE BY USE OF THE A AND B TABLES.

This is given in response to an inquiry by a correspondent, who asked for an explanation of author's remark about the tables doing this, in the preface to the first edition in 1883.

EXAMPLE PLOTTED ON CHARTLET FACING PAGE 104.

Lat. 46 0 N	A 4·77 S	Lat. 46 0 gives Long. 16 8·9 W	H.A. 0 49 53
Dl. 23 27 S	B 2·05 N	Cor. for 10 N = 27·2 E	− 1 49
H. M.			0 48 4
H.A. 0 49 E	C 2·72 S to W or N to E	Lat. 46 10 N gives Long. 15 41·7 W	− 1 0
			0 47 0 for next

Cor. for 10′ N = 27·2 E = 1 49 (M. S.)

Lat. 46 15 N	A 5·02 S	Lat. 46 10 N gives Long. 15 41·7 W	H.A. 0 48 4
Dl. 23 27 S	B 2·12 N	Cor for 10 N = 29·0 E	− 1 56
H. M.			0 46 8
H.A. 0 47 E	C 2·90 S	Lat. 46 20 N gives Long. 15 12·7 W	− 1 0
			0 45 0 for next.

Cor. for 10′ N = 29·0 E = 1 56 (M. S.)

Lat. 46 25 N	A 3·28 S	Lat. 46 20 N gives Long. 15 12·7 W	H.A. 0 46 8
Dl. 23 27 S	B 2·22 N	Cor. for 10 N = 30·6 E	− 2 2
H. M.			0 44 6
H.A. 0 45 E	C 3·06 S	Lat. 46 30 N gives Long. 14 42·1 W	− 1 0
			0 43 0 for next.

Cor. for 10′ N = 30·6 E = 2 2 (M. S.)

Lat. 46 35 N	A 5·56 S	Lat. 46 30 N gives Long. 14 42·1 W	H.A. 0 44 6
Dl. 23 27 S	B 2·32 N	Cor. for 10 N = 32·4 E	− 2 10
H. M.			0 41 56
H.A. 0 43 E	C 3·24 S	Lat. 46 40 N gives Long. 14 9·7 W	− 1 6
			0 40 50 for next.

Cor. for 10′ N = 32·4 E = 2 10 (M. S.)

Lat. 46 45 N	A 5·88 S	Lat. 46 40 N gives Long. 14 9·7 W	H.A. 0 41 56
Dl. 23 27 S	B 2·44 N	Cor. for 10 N = 34·4 E	− 2 18
H. M.			0 39 38
H.A. 0 41	C 3·44 S	Lat. 46 50 N gives Long. 13 35·3 W	− 1 10
			0 38 28 for next.

Cor. for 10′ N = 34·4 E = 2 18 (M. S.)

Lat. 46 55 N	A 6·30 S	Lat. 46 50 N gives Long. 13 35·3 W
Dl. 23 27 S	B 2·54 N	Cor. for 10 N = 37·6 E
H. M.		
H.A. 0 38½	C 3·76 S	Lat. 47 0 N gives Long. 12 57·7 W

Cor. for 10° N = 37·6 E = 2 30 (M. S.)

[NOTE.—It will be seen that as the latitude increases so the H.A. will decrease, according to the change of longitude, 15′ of long. making 1m change of time in the H.A. Therefore, to get the true cor. we must use the *mean* H.A. and the *mean* lat. corresponding to the two parallels which we require the cor. for. The long. found by the application of the A and B cor. at 47° N is practically the same as that found by direct calculation.]

DOUBLE-ALTITUDE POSITION BY TWO STELLAR OBSERVATIONS.

1902.—On 15th March, p.m., the following observations were taken in the artificial horizon, at 50 Hawker Street, Wellington: True position from chart, lat. 41° 17′ 32″ S., long. 174° 46′ 57″ E. :—

	D.	H.	M.	S.					
M.T. at Greenwich by chron.	14	21	6	6	Obsd. alt. of * Sirius	116	33	0	to N. Wd.
" " "	14	22	26	7	" * Canopus	112	10	10	to S. Wd.

Required the true bearing of both stars, and the position of place, assuming latitude to be 41° 0′ S. (17½′ in error). Index error of sextant + 1′ 20″.

	D.	H.	M.	S.		H.	M.	S.
M.T.G.	14	21	6	6	Sid. T. (G. noon)	23	24	40·46
M. ⊙'s R.A.	+ 23	28	8·45		Accl. 21 h. 6 m.	+	3	27·99
Sid. T. G.	20	34	14·45		M. ⊙'s R.A.	23	28	8·45

	H.	M.	S.		H.	M.	S.
M.T.G.	22	26	7	Sid. T. (G. noon)	23	24	40·46
M. ⊙'s R.A.	23	28	21·6	Accl.	+	3	41·13
Sid. T. G.	21	54	28·6	M. ⊙'s R.A.	23	28	21·59

* SIRIUS TO N.WD.

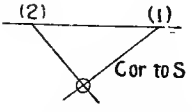
	°	′	″			°	′	″
Obsd. alt. of *	116	33	0	Dl.		16	35	14 S
I. E.	+	1	20			90	0	0
	2) 116	34	20	P. D.		73	24	46
App. alt.	58	17	10					
Ref.	−		34					
A	58	16	36					
L	41	0	0	Sec		0·122220		
P	73	24	46	Cosec		0·018460		
	172	41	22					
S	86	20	41	Cos		8·804503		
S − A	28	4	5	Sine		9·672578		
	H.	M.	S.					
*'s H.A.	1	34	0·2	Sine²		8·617761		
*'s R.A.	6	40	51·6					
Sid. T. place	8	14	51·8	A		2′·00 N		
" Green.	20	34	14·45	B		·75 S		
Long. in time	11	40	37·35	C		1′·25 N to		
Long. (1)	175°	9′	20″ E	gives Az. N 46·6° W				
17·6′ × 1·25′		22	0 W	and C² gives Pos.-line				
Long. in	174	47	20 E	N 51·3 E				
				S 51·3 W				

* CANOPUS TO S.WD.

	°	′	″			°	′	″
Obsd. alt. of *	112	10	10	Dl.		52	38	59 S
I. E	+	1	20			90	0	0
	2) 112	11	30	P. D.		37	21	1
App. alt.	56	5	45					
Ref.	−		38					
A	56	5	7					
L	41	0	0	Sec		0·122220		
P	37	21	1	Cosec		0·217036		
	134	26	8					
S	67	13	4	Cos		9·587969		
S − A	11	7	57	Sin		9·285798		
	H.	M.	S.					
*'s H.A	3	10	41·3 W	Sin²		9·213023		
*'s R.A.	6	21	47·6					
Sid. T. place.	9	32	28·9	A		0′·79 N		
Sid. T. Green	21	54	28·6	B		1′·77 S		
Long. in time	11	38	0·3	C		0′·98 S to E		
Long. (2)	174°	30′	5″ E	gives Az. S 53½° W				
Long. (1)	175	9	20	and C² gives Pos.-line				
Diff. long.		39′	15″	S 44·4° E				

Long. (1) cor. = 1′·25 S to W
" (2) " 0′·98 S to E

D. long. 2′·23 : d. long. 39′·25′ :: lat. 1′ : lat. cor. 17′·6′



	°	′	″					
Lat. used	41	0	0 S	Long. by Canopus	174	30	5 E	
Cor.		17	36 S	17′·6′ × 0′·98′ =		17	15 E	
Lat. in	41	17	36 S	Long. in	174	47	20 E	

The above were *bona fide* observations taken on a windy night, needing patience to wait till the quicksilver was quite steady; being on different sides of the prime vertical, the observations naturally give a good latitude, as 1′ error of altitude due to instrument or refraction would make practically *no* difference in the resulting latitude. This problem reworked with a latitude near the truth only makes a few seconds difference in the resulting position.

[NOTE.—A, true alt.; L, lat.; P, Polar dist.; S, half sum of A + L + P; S − A, diff. between S and A; H.A., hour-angle.]

DOUBLE-ALTITUDE POSITION BY TWO STELLAR OBSERVATIONS.

1902.—On 15th March, p.m., the following observations were taken in the artificial horizon :—

	D. H. M. S.		° ′ ″
M. T. at Greenwich by chron.	14 21 23 43	Obsd. alt. of ✱ *a* Centauri	69 36 50 to S.Ed.
" " "	14 22 26 7	" ✱ Canopus	112 10 10 to S.Wd.

Required the true bearing of both stars, and the position of place, assuming latitude to be 41° 0′ S. Index error of sextant + 1′ 20″.

1ST OBSERVATION.

	H. M. S.	Dl. of ✱ *a* Centauri.
M. T. Green.	21 23 43	° ′ ″
Sid. T. (G. noon)	23 24 40·46	60 25 37 S
Accl.	+ 3 30·89	90 0 0
Sid. T. Green.	20 51 54·35	P. D. 29 34 23

2ND OBSERVATION.

	H. M. S.	Dl. of ✱ Canopus.
M. T. G.	22 26 7	° ′ ″
Sid. T. (G. noon)	23 24 40·46	52 38 59 S
Accl.	+ 3 41·13	90 0 0
Sid. T. Green.	21 54 28·59	P. D. 37 21 1

✱ *a* CENTAURI TO S.ED.

	° ′ ″		
Obsd. alt. of ✱	69 36 50		
I. E.	+ 1 20		
	2) 69 38 10		
App. alt.	34 49 5		
Ref.	− 1 22		
T. alt.	34 47 43		
Lat.	41 0 0	Sec	0·12222
P. D.	29 34 23	Cosec	0·306684
	105 22 6		
S	52 41 3	Cos	9·782622
S − A	17 53 20	Sin	9·487382
	H. M. S.		
✱'s H.A.	5 59 58·0 E	Sin²	9·698908
✱'s R.A.	14 33 1·3		
Sid. T. place	8 33 3·3	A	′·00
Sid. T. G.	20 51 54·3	B	1′·76 S
Long. in T.	11 41 9·0	C	1′·76 S gives Az. S 37° E
Long. (1)	175° 17′ 15″ E		
Long. (2)	174 30 5 E	C² Pos.-line S 60·4° W	
Diff. long.	47 10 = 47′·17		

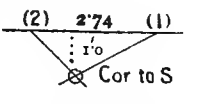
✱ CANOPUS TO S.WD.

	° ′ ″		
Obsd. alt. of ✱	112 10 10		
I. E.	+ 1 20		
	2) 112 11 30		
App. alt.	56 5 45		
Ref.	− 38		
T. alt.	56 5 7		
Lat.	41 0 0	Sec	0·122220
P. D.	37 21 1	Cosec	0·217036
	134 26 8		
S	67 13 4	Cos	9·587969
S − A	11 7 57	Sin	9·285798
	H. M. S.		
✱'s H.A.	3 10 41·3 W	Sin²	9·213023
✱'s R.A.	6 21 47·6		
Sid. T. lace	9 32 28·9	A	′·79 N
Sid. T. G.	21 54 28·6	B	1′·77 S
Long. in T.	11 38 0·3	C	′·98 S to E
Long. (2)	174° 30′ 5″ E	gives Az. S 53½° W	
		C² Pos.-line S 44·4° E.	

Long. (1) cor. = 1′·76 S to W
" (2) " 0·98 S to E

D. long. 2′·74 : d. long. 47′·17′ lat. 1′ : lat. cor. 17′·22′ = 17′ 13″

	° ′ ″		° ′ ″
Lat. used	41 0 0 S	Long. (2)	174 30 5 E
Cor.	17 13 S	17′·22′ × ·98′ = cor.	16 53 E
Lat. in	41 17 13 S	Long. in	174 46 58 E



These observations were taken on the same evening as those given on the preceding page. As one star was east of the meridian and the other one west, the case is not good for latitude; but it should give the truest longitude, as instrumental errors, &c., will practically eliminate one another in the resulting longitude. This problem reworked with a latitude near the truth makes no appreciable difference in the resulting position.

For position of ship when plotted on chart, see chartlet on next page.

DOUBLE ALTITUDE OF TWO STARS

(Combining Chron. Long. Observation with an Ex-meridian).

1902.—On 15th March, p.m., the following observations were taken :—

	D.	H.	M.	S.						
M. T. G. by chron.	14	21	23	43	T. alt. of * α Centauri	34	47	43	to S.Ed.
M. T. G. "	14	22	26	7	" * Canopus	56	5	7	to S.Wd.

Required position of place by projection on the chart, assuming the approximate latitude to be 41° 0′ S.

* Canopus to S.Wd.

	H.	M.	S.
M. T. G.	22	26	7
Sid. T. (G. noon)	23	24	40·46
Accl.	+	3	41·13
Sid. T. Green.	21	54	28·59

	°	′	″
A	56	5	7
L	41	0	0
P	37	21	1
	134	26	8
S	67	13	4
S − A	11	7	57

	H.	M.	S.	
*'s H.A.	3	10	41·3	W
*'s R.A.	6	21	47·6	
Sid. T. place	9	32	28·9	
Sid. T. G.	21	54	28·6	
Long. in T.	11	38	0·3	
Long.	174°	30′	5″	E

Dl. of * 52° 38′ 59″ S

P. D. 37 21 1

Sec 0·122220

Cosec 0·217036

Cos 9·587969

Sin 9·285798

Sin² 9·213023

A ′79 N

B 1·77 S

Cor ·98 S Pos.-line from C² gives S 44·4° E

* α Centauri to S.Ed.

	H.	M.	S.
M. T. G.	21	23	43
Long. in T. +	11	38	0·3
M. T. place	9	1	43·3
M. ⊙'s R.A.	23	28	11·3
Sid. T. place	8	29	54·6
*'s R.A.	14	33	1·3
*'s H.A.	6	3	6·7

Supt. 5 56 53·3 / 89° 13′ 20″ } Cos 8·132720

Dl. 60 25 37 Cot 9·753933 Cosec 0·060617

Arc (1)* 0° 26′ 29″ S Tan 7·886653 Cos 9·999987

Alt. 34° 47′ 43″ Sin 9·756366

Sin 9·816970

	H.	M.	S.
Sid. T. G. noon	23	24	40·46
Accl.	+	3	30·89
M. ⊙'s R.A.	23	28	11·35

*'s Dl. = 60° 25′ 37″ S

Arc (2) 41 0 11 S

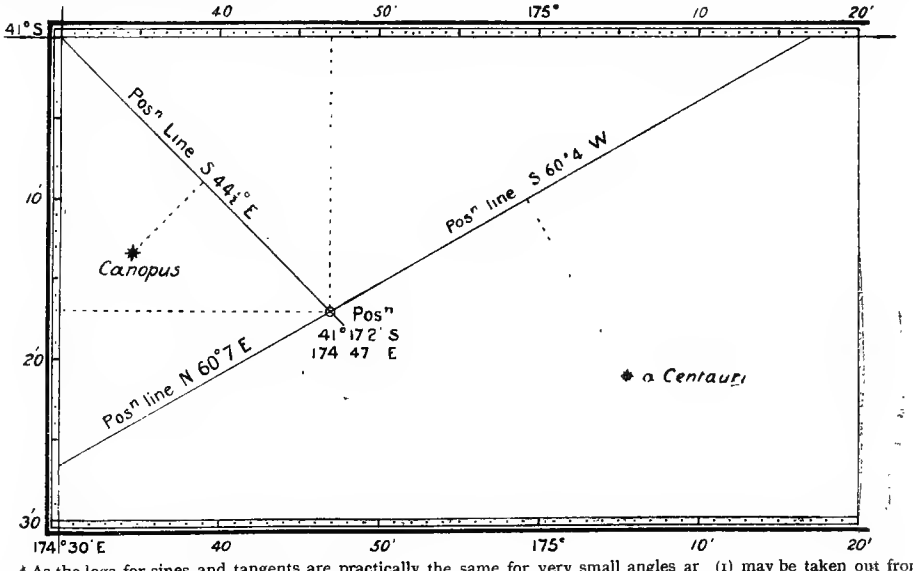
Latitude 41 26 40 S

A ·01 S

B 1·77 S

Cor 1·78 S gives Pos.-line S 60·7° W

The chartlet below serves to illustrate both the problem above and the one on previous page. In the first case the position-lines are laid down from the two longitudes corresponding to the parallel of latitude 41° S., and in the second case the position-lines are laid down from the meridian of longitude 174° 30′ E., the longitude found by chronometer from observation of star Canopus in latitude 41° S. The observation of star α Centauri is worked as an ex-meridian from the time deduced from longitude 174° 30′ E. Though the hour-angle in this case is a little over six hours, the latitude found is perfectly correct.



* As the logs for sines and tangents are practically the same for very small angles ar (1) may be taken out from the log sine table to save calculating for the seconds.

SIMULTANEOUS[a] OBSERVATIONS OF TWO DIFFERENT STARS BY THE OLD "SUMNER" METHOD.

1898. — Shortly after sunset on March 3rd, somewhere between the parallels of 51° 15′ N. and 51° 50′ N., a chronometer indicated mean time at Greenwich 3 d. 6 h. 48 m. 38 s. when the true altitude of * Procyon was 31° 57′ east of meridian; again, after running east (true) 3¾ m., a chronometer indicated 3 d. 6 h. 59 m. 20 s. when the true altitude of * Capella was 83° 50′ east of meridian.

Required the position of the ship at time of last observation, and the true bearing of the stars by Sumner's method of progression on the chart.

1ST OBSERVATION: * PROCYON TO S.ED.

	D. H. M. S.		° ′
M. T. Green.	3 6 48 38	T. alt. of *	31 57 E
Sid. T. (G. noon)	22 45 7·9		
Accl.	+ 1 7·1		
		* 's Dl.	5 29 N
Sid. T. Green.	5 34 53·0	P D	84 31 N

2ND OBSERVATION: * CAPELLA TO S.ED.

	D. H. M. S.		° ′
M. T. Green.	3 6 59 20	T. alt. of *	83 50E
Sid. T. (G. noon)	22 45 7·9		
Accl.	+ 1 8·9		
		* 's Dl.	45 51 N
Sid. T. Green.	5 45 36·8	P D	44 6 N

Run between observations, East 3·75 m. = d. long. 6′·0 E.

A	31 57	Sec	0·203479
L	51 15	Cosec	0·001992
P	84 31		
	167 43		
S	83 51½	Cos	9·029332
S − A	51 54½	Sin	9·895988
	H. M. S.		
* 's H.A.	− 2 52 33·0 E	Sin²	9·130791
* 's R.A.	7 34 0·3		
Sid. T. Sp.	4 41 27·3		
Sid. T. G.	5 34 53·0		
Long. in T.	0 53 25·7		
Long	13° 21′ 25″ W		
Run	6 0 E		
Long. A	13 15 25 W		

A	83 50	Sec	0·20348
L	51 15	Cosec	0·15745
P	44 6		
	179 11		
S	89 35½	Cos	7·85289
S − A	5 45½	Sin	9·00144
	H. M. S.		
* 's H.A.	− 0 18 34·6 E	Sin²	7·21526
* 's R.A.	5 9 11·4		
Sid. T. Sp.	4 50 36·8		
Sid. T. G.	5 45 36·8		
Long. in T.	0 55 0·0		
Long. C	13° 45′ 0″ W		

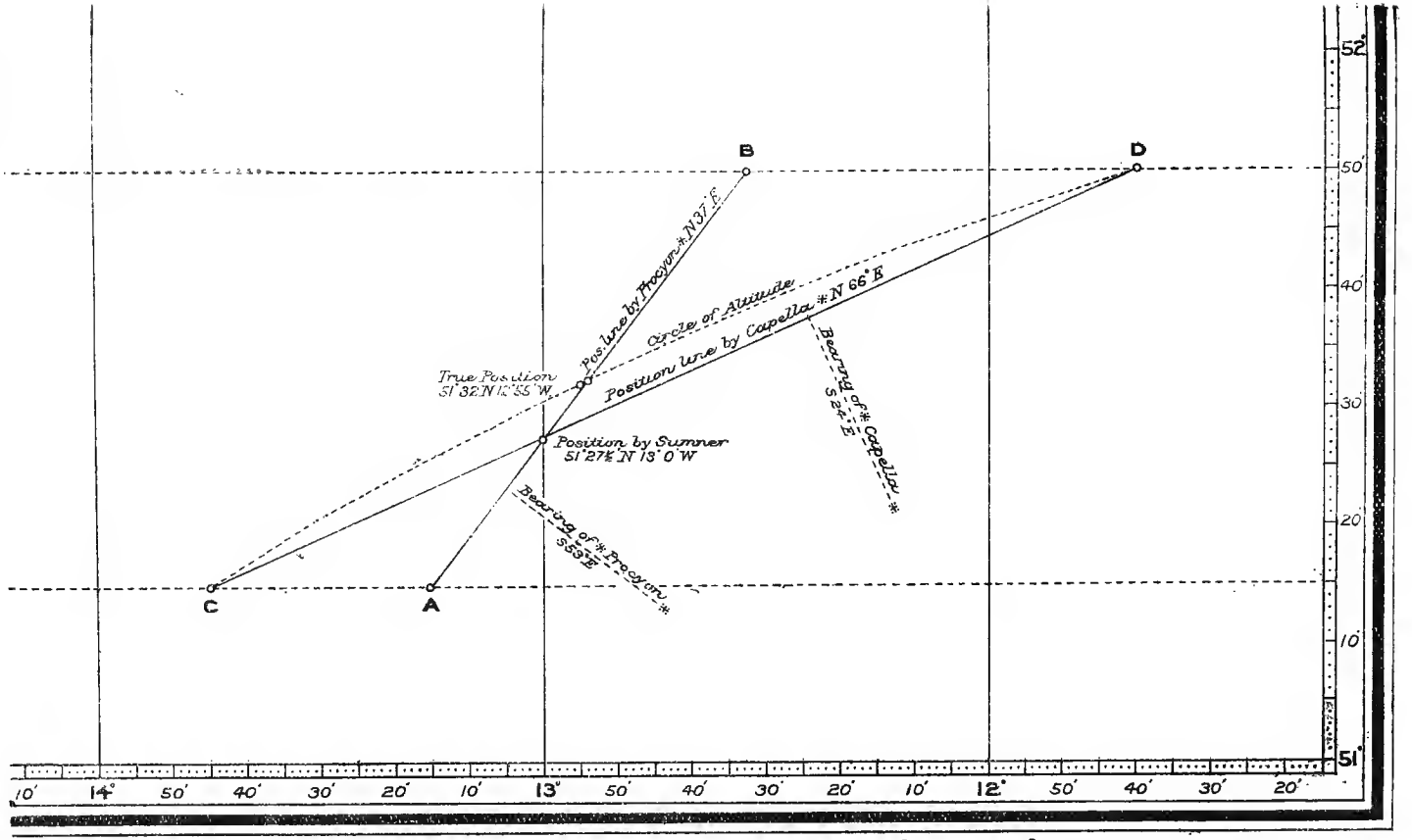
A	31 57	Sec	0·209046
L	51 50	Cosec	0·001992
P	84 31		
	168 18		
S	84 9	Cos	9·008278
S − A	52 12	Sin	9·897712
	H. M. S.		
* 's H.A.	− 2 49 42·3 E	Sin²	9·117028
* 's R.A.	7 34 0·3		
Sid. T. Sp.	4 44 18·0		
Sid. T. G.	5 34 53·0		
Long. in T.	0 50 35·0		
Long.	12° 38′ 45″ W		
Run	6 0 E		
Long. B	13 32 45 W		

A	83 50	Sec	0·20905
L	51 50	Cosec	0·15744
P	44 6		
	179 46		
S	89 53	Cos	7·30882
S − A	6 3	Sin	9·02283
	H. M. S.		
* 's H.A	− 0 10 14·4 E	Sin²	6·69814
* 's R.A.	5 9 11·4		
Sid. T. Sp.	4 58 57·0		
Sid. T. G.	5 45 36·8		
Long. in T.	0 46 39·8		
Long. D	11° 39′ 57″ W		

Position of ship by Sumner: Lat. 51° 27½′ N., long. 13° 0′ W.
True position of ship: Lat. 51° 32′ N., long. 12° 55′ W.
Bearing of * Procyon, S. 53° E.; and bearing of * Capella, S. 24° E.

[a] Practically though not absolutely simultaneous.

NOTE. — This is the problem (c) of the Board of Trade Examination for Extra Master, with the exception that as set for that examination both observations are taken at the same instant, only one chronometer time being given. As this is probably never realised in practice, the more usual experience of having a few minutes' interval between the observations is here given.



NOTE. *The difference between the true circle of altitude from A to B and the straight line joining these two points is so small that it could not be well shown on this chartlet. The straight line cuts the circle of altitude between C and D at lat. 51° 32½' N. and long. 12° 54' W. The true position of ship, where the two circles of altitude would cut, is lat. 51° 32' N. and long. 12° 55' W.*

SIMULTANEOUS OBSERVATIONS OF TWO DIFFERENT STARS BY THE IMPROVED "SUMNER" METHOD.

1898.—Shortly after sunset on March 3rd, in latitude by D.R. 51° 15′ N., a chronometer indicated mean time at Greenwich 3 d. 6 h. 48 m. 38 s. when the true altitude of * Procyon was 31° 57′ east of meridian; again, after running east (true) 3¾ m., a chronometer indicated 3 d. 6 h. 59 m. 20 s. when the true altitude of * Capella was 83° 50′ east of meridian.

Required the position of the ship at the time of last observation, and the true bearing of each star at the time of their observation.

1ST OBSERVATION: * PROCYON TO S.ED.

	H. M. S.		° ′
M. T. Green.	6 48 38	T. alt. of *	31 57
Sid. T. (G. noon)	22 45 7·9		
Accl.	+ 1 7·1	Dl.	5 29 N
Sid. T. Green	5 34 53·0	P.D.	84 31 N

Run between observations, East 3·75 m. = d. long. 6·0′ E.

	° ′		
A	31 57		
L	51 15	Sec	0·203479
P	84 31	Cosec	0·001992
	167 43		
S	83 51½	Cos	9·029332
S − A	51 54½	Sin	9·895988
	H. M. S.		
*'s H.A.	2 52 33·0 E	Sin²	9·130791
*'s R.A.	7 34 0·3		
Sid. T. Sp.	4 41 27·3		
Sid. T. G.	5 34 53·0		
Long. in T.	0 53 25·7	Lat. 51½°	A 1′33 S
		* Procyon	B ·14 N
Long.	13° 21′ 25″ W	H. M. H.A. 2 52	C 1′19 S
Run	6 0 E		
Long. (1)	13° 15′ 25″ W	Gives Az. S 53·3° E and Pos.-line N 36·7° E	
	H. M. S.		
Long. in T.	0 53 1·7		

2ND OBSERVATION: * CAPELLA TO S.ED.

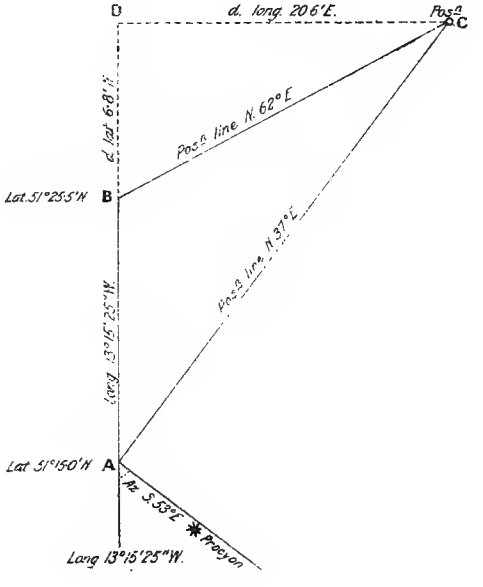
	H. M. S.		° ′
M. T. Green.	6 59 20	T. alt. of *	83 50 Sd
Long. in T.	− 0 53 1·7 W	Z.D.	6 10
M. T. Sp.	6 6 18·3		
Sid. T. (G. noon)	22 45 7·9		
Accl.	+ 1 8·9		
Sid. T. Sp.	28 52 35·1		
*'s R.A. (+24)	29 9 11·4		
*'s H.A.	0 16 36·3 E	Sin	8·8595
Dec.	45° 54′ N	Cos	9·8426
Alt.	83° 50′	Sec	0·9689
Az.	S 27° 57′ E	Sin	9·6710
Pos.-line	N 62° E.		

LAT. BY EX-MER. TABLE NO. 3 OF BLACKBURNE'S AND WESTLAND'S TABLES.

	H. M.		° ′		° ′
H.A.	0 16·6	Cor.	+ 4′5	Alt.	83 50 Cor. − 43
Dec.	45° 54′ N		45 54	Az.	27 57 Z D 6 10 N
Arc (1)			45° 58′5′ N	Arc (2)	5 57 N
Arc (2)			5 57 N		
Lat.			51° 25′5′ N		

1st obsn. *'s Az. S 53·3° E gives lat. error from Table M ·84 N to E at lat. 51 15 N
2nd obsn. *'s Az. S 28° E gives lat. error from Table M ·33 N to E at lat. 51 25·5 N

			° ′	long.	long. cor.
Lat. error ·51	diff. lat.	10·5		1·0′	20·6′



	° ′
Long.	13 15·4 W
Cor.	20·6 E
Long. in	12 54·8 W
Lat.	51 25·5 N
Cor.	6·8 N
Lat. in	51 32·3 N

	′
	20·6 × ·33
	·618
	6·18
Cor.	6·798 N

IMPROVED "SUMNER" POSITION FROM TWO STELLAR OBSERVATIONS

(Combining Chron. Long. Observation with an Ex-meridian below the Pole).

1898.—Soon after sunset on 25th December, at about 8 h. 2 m. p.m., in latitude by D.R. 46° S., and longitude 164° 30′ E., Suppose the following observations:—

M. T. Green. 21 h. 1 m. 20 s. when T. alt. of ✱ Sirius was 28° 26′ E. of meridian.

M. T. Green. 21 h. 7 m. 26 s. when T. alt. of α Crucis was 20° 45′ E. of meridian.

Run in interval between observations, S. 80°, E. 1 m. = dep. 0·98′ = d. long. 1·4′ E.

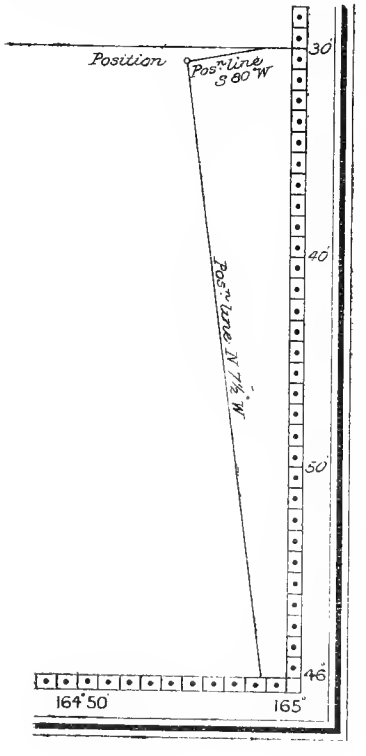
Required the position of ship at time of second observation.

1st Observation.

	H. M. S.		
M. T. Green.	21 1 20	Dl. of ✱ Sirius.	
Sid. T. (G. noon)	18 12 8·3		° ′
Accl.	3 27·2		16 35 S
Sid. T. Green.	15 16 55·5	P.D.	73 25

✱ Sirius to N.Ed.

	° ′		
A	28 26		
L	46 0	Sec	0·158229
P	73 25	Cosec	0·018451
	147 51		
S	73 55½	Cos	9·442316
S − A	45 29½	Sin	9·853180
	H. M. S.		
✱'s H.A.	− 4 23 59 E	Sin²	9·472176
✱'s R.A.	6 40 44		
Sid. T. Sp.	2 16 45	A	′46 N
Sid. T. Green.	15 16 55·5	B	·33 S
Long. in T.	10 59 49·5	C²	·13 N
Long.	164° 57′ 22″ E	Pos.-line	N 7½° W
Run	1 24 E		
Long. (1) at time of 2nd obsn.	164 58 46 E = 10h. 59m. 55s.		



2nd Observation: ✱ α Crucis.

	H. M. S.		H. M. S.
M. T. Green.	21 7 26	Sid.T. (G. noon)	18 12 8·3
Long. E	+ 10 59 55	Accl.	+ 3 28·0
M. T. Sp.	8 7 21	M. ⊙'s R.A.	18 15 36·3
M. ⊙'s R.A.	18 15 36·3		
		H. M.	′
Sid. T. Sp.	− 2 22 57·3	H.A. 9 58	A 1·76 S
✱'s R.A.	12 20 59·6	Lat. 46° S	B 3·80 S
✱'s H.A.	− 9 58 2·3 E	✱ α Crucis	C 5·56 S
	12 0 0		
		gives Az. S 14°·5 E	
Supt.	2 1 58		

Table C² gives Posn.-line for Plane Chart, S 79½° W

For Latitude by Ex-meridian Table No. 3 of Blackburne's and Westland's Tables.

Decl.	62° 32′ S	p. 149	Arc cor.	− ° ′ 3 20·3
H.A.	2h. 2m.		P D	27 28·0 S
			Arc (1)	24 7·7 S
Alt.	° ′ 20 45 S	p. 145	Arc cor.	+ ′ 0 37·3
Az.	14 30 S		Alt.	20 45·0 S
			Arc (2)	21 22·3 S
			α (1)	24 7·7 S
			Lat.	45 30·0 S

Rule for Use of Ex-meridian Table No. 3.

With Hour-angle from Lower Meridian

With declination and hour-angle take out arc reduction; *subtract* this reduction from P D for arc (1).

With altitude and azimuth take out 2nd arc reduction; *add* this reduction to altitude for arc (2).

Arc (1) + arc (2) = latitude.

✱ Sirius with latitude 46° S. gives longitude 164° 58′ 45″ E., and position-line for plane chart N. 7½° W.

✱ α Crucis with longitude 164° 58′ 45″ E. gives latitude 45° 30′ S., and position-line S. 80° W.

Chart position: Latitude 45° 30·7′ S., longitude 164° 55′ E.

High-declination stars, such as α Crucis, are very useful for ex-meridians, as, if the time is only approximately correct, the latitude will not be far from the truth if the body is within an hour from the meridian below the Pole.

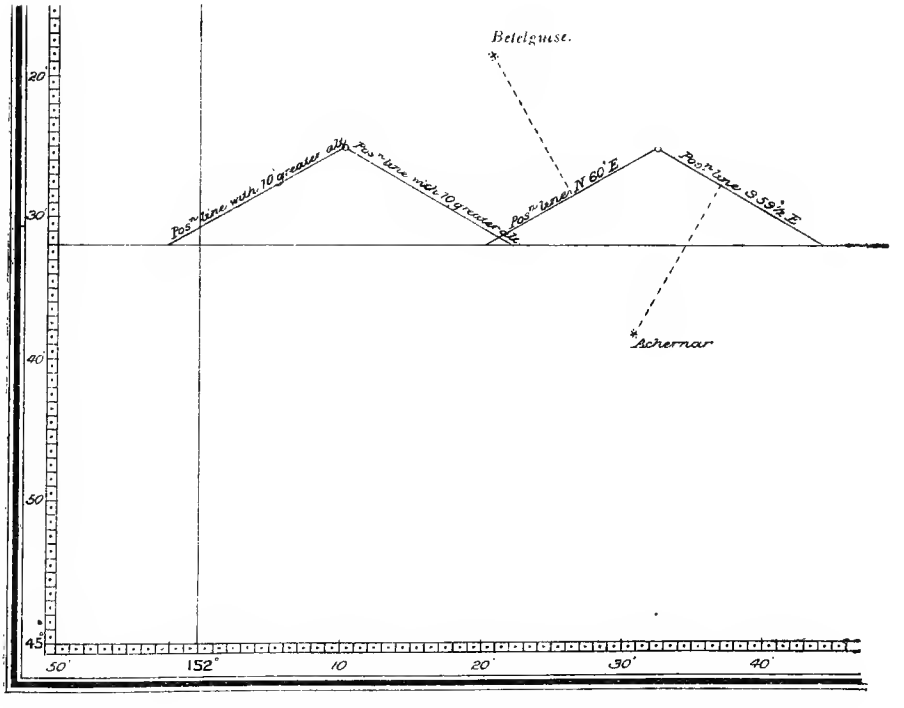
In this example, notwithstanding that the star α Crucis is over 2 hours from the lower meridian passage, 1 m. of error in the time used for ex-meridian would only make 2½′ of error in the resulting latitude.

THE SUPERIORITY OF STELLAR OVER SOLAR OBSERVATIONS.

The two great advantages of stellar over solar observations are (1) that by the stars the latitude and longitude can be obtained simultaneously, instead of having an interval of three or four hours between the observations as is often the case when the sun is used, and (2) that uncertain errors in altitude resulting from personal equation, arc errors of sextant, or exceptional refraction may be practically eliminated by a proper choice of stars. If meridian altitudes can be obtained about the same time to the north and south of observer, it will be apparent to any one that the errors would be eliminated by taking the mean result of the two observations for the true latitude; and in the same way the true longitude would be found by the mean result of observations taken nearly east and west of meridian. But it may happen that stars are not to be found north, south, east, and west of observer during the short time that the horizon is good for observation. The following is the plan that the writer used for several years with great success: Take three stars, and of these choose two on the *same* side of the meridian northward and southward of the observer for a good *latitude*. If they both happen to be the same distance from the meridian, as in the following example, 10′ of error in the altitude will make practically *no difference* in the resulting latitude as found by the "Sumner" or double-altitude problem. Then choose another star on the other side of the meridian, as near as possible the same distance from the meridian; calculate the longitude with the latitude found from the previous observations, and the true longitude will be obtained by taking the mean between the eastern and western stars worked with the correct latitude.

Elimination of Errors in Altitude.

Diagram showing how the true latitude may be found by the "Sumner" method even when altitudes have been observed by a sextant with large unknown arc errors.



See worked-out example from which this is taken on the following two pages.

POSITION OF SHIP FROM OBSERVATION OF THREE STARS,

Thereby eliminating Errors in Position resulting from Unknown Errors in Altitude.

1898.—On March 18th, at 8 h. 11 m. p.m., A.T. at ship, in latitude by D.R. 44° 32′ S., longitude 152° 20′ E. Required the position of ship from the following observations:—

				D. H. M. S.
(1) ✱ Achernar's corrected alt.	33° 27′	W of mer. when chron. showed	M. T. Green.	17 22 5 50
(2) ✱ Betelgnese	30 13	W " " "	"	17 22 9 33
(3) ✱ β Centauri	38 32	E " " "	"	17 22 12 17

Ship making a true east course at speed of 12 miles per hour.

(1) Decl.	57° 45′ 17″ S	(2) Decl.	7° 23′ 16″ N	(3) Decl.	59° 52′ 58″ S
	90 0 0		90 0 0		90 0 0
P. D.	32 14 43	P. D.	97 23 16	P. D.	30 7 2

Sid. T. (G. Noon).	H. M. S.	Sid. T. (G. Noon).	H. M. S.	Sid. T. (G. Noon).	H. M. S.
17th	23 40 19·67	. . . . .	23 40 19·67	. . . . .	23 40 19·76
Accl. 22 h. 5¾ m.	+ 3 37·80	Accl. 22 h. 9½ m.	+ 3 38·40	Accl. 22 h. 12¼ m.	+ 3 38·86
Cor. Sid. T.	23 43 57·47	Cor. Sid. T.	23 43 58·07	Cor. Sid. T.	23 43 58·53
M. T. G.	22 5 50	M. T. G.	22 9 33	M. T. G.	22 12 17
Sid. T. Green.	21 49 47·47	Sid. T. Green.	21 53 31·07	Sid. T. Green.	21 56 15·53

✱ Achernar to S.Wd.

A	33° 27′	Sec	0·147006
L	44 32	Cosec	0·272772
P	32 15		
	101 14		
S	55 7	Cos	9·757326
S − A	21 40	Sin	9·567269
	H. M. S.		
✱'s H.A.	6 25 18·5 W	Sin²	9·744337
✱'s R.A.	1 33 54·4		
Sid. T. Sp.	7 59 12·9	A	·11′ S
Sid. T. Green.	21 49 47·5	B	1·59 S
Long. in T.	10 9 25·4	C²	1·70 S gives
Longitude	152° 21′ 21″ E	Pos.-line	S 59½° E
Run	1 0 E		
Long. (1)	152 22 21 E		

✱ Betelguese to N.Wd

A	30° 13′	Sec	0·147006
L	44 32	Cosec	0·003616
P	97 23		
	172 8		
S	86 4	Cos	8·836297
S − A	55 51	Sin	9·917805
	H. M. S.		
✱'s H.A.	2 11 41·6 W	Sin²	8·904724
✱'s R.A.	5 49 40·6		
Sid. T. Sp.	8 1 22·2	A	1′·52 N
Sid. T. Green.	21 53 31·1	B	1·24 N
Long. in T.	10 7 51·1	C²	1′·76 N gives
Longitude (2)	151° 57′ 46″ E	Pos.-line	N 60½° E
" (1)	152 22 21 E		
Diff. long.	24 35 = 24·6′		

✱ β Centauri to S.Ed.

A	38° 32′	Sec	0·146138
L	44 25	Cosec	0·299502
P	30 7		
	113 4		
	56 32	Cos	9·741508
S − A	18 0	Sin	9·489982
	H. M. S.		
✱'s H.A.	− 5 48 45·3 E	Sin²	9·677130
✱'s R.A.	13 56 41·2		
Sid. T. Sp.	8 7 55·9		
Sid. T. Green.	56 15·6	A	′05 N
		B	1′·73 S
Long. in T.	10 11 40·3	C²	1′·68 S gives
Long.	152° 55′ 5″ E	Pos.-line	S 59·2° W

Long. (1) cor. = 1′·70 S to E
Long. (2) cor. = 1′·76 N to E

D. long. 3′·46 : d. long. 24′·6 :: lat. 1′ : lat. cor. 7′·1 N

Lat. used	44° 32′ 0″ S	Long. (1)	152° 22′ 21″ E
Cor.	7 6 N	7′·1′ × 1′·7′	12 4 W
Lat. in	44 24 54 S	Long. in	152 10 17 E
		Run in interval	45 E
		Long.	152 11 2 E when β Centauri was observed.

Long. by W star 152° 55′ 5″ E
" E star 152 11 2 E

2) 304 66 7

" by mean of obsns. 152 33 3 E

POSITION OF SHIP FROM OBSERVATION OF THREE STARS.

(This is previous example worked with 10′ less altitude for each star. Result the same.)

1898.—On 18th March, at 8 h. 11 m. p.m., A.T. ship, in latitude by D.R. 44° 32′ S., longitude 152° 20′ E. Required the position of ship from the following observations:—

			D. H. M. S.
(1) ✱ Achernar	true alt. 33° 17′	W. of mer. when chron. showed M. T. Green.	17 22 5 50
(2) ✱ Betelguese	" 30 3	W. " " "	17 22 9 33
(3) ✱ β Centauri	" 38 22	E. " " "	17 22 12 17

Ship making a true east course at speed of 12 miles per hour.

(1) Decl.	57 45 17 S	(2) Decl.	7 23 16 N	(3) Decl.	59° 52′ 58″ S
	90 0 0		90 0 0		90 0 0
P. D.	32 14 43		97 23 16		30 7 2

Sid. T. (G. Noon).	H. M. S.	Sid. T. (G. Noon).	H. M. S.	Sid. T. (G. Noon).	H. M. S.
17th	23 40 19·67	. . . . .	23 40 19·67	. . . . .	23 40 19·67
Accl. 22 h. 5¾ m.	+ 3 37·80	Accl. 22 h. 9½ m.	+ 3 38·40	Accl. 22 h. 12¼ m.	+ 3 38·86
Cor. Sid. T.	23 43 57·47	Cor. Sid. T.	23 43 58·07	Cor. Sid. T.	23 43 58·53
M. T. Green.	22 5 50	M. T. Green.	22 9 33	M. T. Green.	22 12 17
Sid. T. Green.	21 49 47·47		21 53 31·07	Sid. T. Green.	21 56 15·53

✱ Achernar to S.Wd.

A	33° 17′		
L	44 32	Sec	0·147006
P	32 15	Cosec	0·272772
	110 4		
S	55 2	Cos	9·758230
S − A	21 45	Sin	9·568856
	H. M. S.		
✱'s H.A.	6 26 46·9 W	Sin²	9·746864
✱'s R.A.	1 33 54·4		
Sid. T. Sp.	8 0 41·3	A	12′ S
Sid. T. Green.	21 49 47·5	B	1 59 S
Long. in T.	10 10 53·8	C²	1·71 S gives
Longitude	152° 43′ 27″ E	Pos.-line	S 59·6° E
Run	1 0 E		
Long. (1)	152 44 27 E		

✱ Betelguese to N.Wd.

A	30° 3′		
L	44 32	Sec	0·147006
P	97 23	Cosec	0·003616
	171 58		
S	85 59	Cos	8·845387
S − A	55 56	Sin	9·918233
	H. M. S.		
✱'s H A.	2 13 11·2 W	Sin²	8·914242
✱'s R.A.	5 49 40·6		
Sid. T. Sp.	8 2 51·8	A	1·50 N
Sid. T. Green.	21 53 31·1	B	·24 N
Long. in T.	10 9 20·7	C²	1·74 N gives
Longitude (1)	152° 20′ 10″ E	Pos.-line	N 60·1° E
" (2)	152 44 27 E		
Diff. long.	24 17 = 24·3′		

✱ β Centauri to S.Ed.

A	38° 22′		
L	44 25	Sec	0·146138
P	30 7	Cosec	0·299502
	112 54		
S	56 27	Cos	9·742462
S − A	18 5	Sin	9·491922
	H. M. S.		
✱'s H.A.	5 50 12·8 E	Sin²	9·680024
✱'s R.A.	3 56 41·2		
Sid. T. Sp.	8 6 28·4		
Sid. T. Green.	21 56 15·5		
Long. in T.	10 10 12·9		
Long.	152° 33′ 14″ E		

Long. by W star	152° 33′ 14″ E	
" E star	152 33 10 E	
" by mean of obsns.	152 33 12 E	

Long. (1) cor.	1·71 S to E
Long. (2) cor.	1·74 N to E
D. long.	3·45 : d. long. 24·3′ : : lat. 1′ : lat. cor. 7·04′

Lat. used	44° 32′ 0″ S	
Cor.	7 0 N	
Lat. in	44 25 0 S	
Long. (1)	152° 44′ 27″ E	
7·04′ × 1·71	12 2 W	
	152 32 25 E	
Run in interval	45 E	
Long.	152 33 10 E	when β Centauri was observed.

With the above correct altitudes, the longitude calculated with correct latitude, 44° 25′ S, would be practically the same by all three stars.

EXAMPLES TO FIND STARS SUITABLE FOR DETERMINING POSITION BY SIMULTANEOUS ALTITUDES.

Example 1.

1898.—On 22nd February, at about 5 h. 30 m. p.m., in lat. by D.R. 49° 20′ N., long. 8° 45′ W. Find what stars not less bright than mag. 0·5 are suitable for determining the position of ship by simultaneous altitudes.

	H. M.		H. M.		H. M.		H. M.
A. ⊙'s R.A.	22 24						
A. T. Sp. +	5 30						
R.A. mer.	3 54	. .	3 54	. . .	3 54	. . .	3 54
✱ Capella R.A.	5 9	✱ Rigel	5 10	✱ Sirius	6 40	✱ Procyon	7 34
✱'s H.A.	1 15 E	H.A.	1 16 E	H.A.	2 46 E	✱'s H.A.	3 40 E

	H. M.
R.A. mer. + 24 h.	27 54
✱ Vega	18 33
✱'s H.A.	9 21 W

The only stars of this magnitude (not including planets) which would be above the horizon would be Capella, Rigel, Sirius, and Procyon east of meridian, and Vega to the west.

Rigel and Capella, having nearly the same R.A. and a large difference in declination, will always make a good cut with one another; also, position-lines from Vega and Capella will nearly always cross one another at a good angle in the Northern Hemisphere, as these stars are about 10½ hours apart in R.A., and in high northern latitudes they both remain almost continuously above the horizon. In this case either Capella or Procyon, worked for longitude, would make a good cut with any of the other three stars, which would be nearer the meridian than the prime vertical, and could therefore be worked for latitude, Rigel and Sirius being to the south and Vega to the north.

Example 2.

1898.—On 25th June, at about 5 h. p.m., in lat. by D.R. 40° S., long. 171° E. Find what stars not less bright than mag. 0·5 are suitable for determining the position of ship by simultaneous altitudes.

	H. M.		H. S.		H. M.
A. ⊙'s R.A.	6 16				
A. T. Sp. +	5 0				
R.A. mer.	11 16	. . .	11 16	. . . .	11 16
✱ Achernar R.A.	1 34	✱ Rigel R.A.	5 10	✱ Canopus R.A.	6 22
✱'s H.A.	9 42 W	✱'s R.A.	6 6 W	✱'s H.A.	4 54 W

	H. M.		H. S.		H. M.
R.A. mer.	11 16	. . . .	11 16	. . . .	11 16
✱ Sirius	6 41	✱ Procyon	7 33	✱ Arcturus	14 11
✱'s H.A.	4 35 W	✱'s H.A.	3 43 W	✱'s H.A.	2 55 E

It will be seen at once that Sirius, nearly on the prime vertical, and Achernar, near the meridian below the Pole, will give a splendid position. Canopus would also give a good longitude in combination with Achernar, or position-line from Procyon to N.W. would cross well with Arcturus to N.E. Rigel, having a very small altitude, would probably not be seen.

Note.—The planets Venus, Jupiter, Saturn, and Mars make good daylight stars for observation. Venus, the brightest of all, is nearly always available for longitude either in the early morning or evening. The relative positions of the other planets with the sun vary continuously.

In the Northern Hemisphere Vega and Altair, or Rigel and Capella, nearly always pair well together: when the first pair are morning the other are evening stars, and *vice versa*. In the Southern Hemisphere Canopus and Sirius, or either α or β Centauri and Arcturus, make good pairs for determining positions. In higher latitudes, in place of Arcturus, Achernar will always make a good cut with either of the Centaurs.

DOUBLE-ALTITUDE POSITION BY SUN AND MOON.

LONGITUDE BY CHRONOMETER, AND EX-MERIDIAN 3 HOURS FROM THE MERIDIAN.

1898.—On 2nd January, at about 3 p.m., A.T. at ship, observed altitude of moon's U.L. was 26° 33′ 0″ E. of meridian when chronometer showed M.T. Green. 3 h. 48 m. 30 s., and observed altitude of sun's L.L. was 5° 30′ 45″ W. of meridian when chronometer showed M. T. Green. 3 h. 53 m. 7 s. Latitude by D.R. 51° 30′ N., longitude 12° 20′ W. Height of eye, 33 ft. Run in interval between observations, 1 m. on a true S. 85° E. course = dep. 1·0′ = d. long. 1·6′ E.

Required the position of ship at time of second observation.

Obsd. alt. of ☾	26 33 0 E	☾'s R.A. 4 h.	H. M. S. 2 40 33·3	☾'s decl. 4 h.	° ′ ″ 20 54 29 N
Dip 33 ft.	-- 5 39	2·035 s. × 11·5 m.	− 23·4	8·3″ × 11·5 m.	1 35 S
	26 27 21	Cor. R.A.	2 40 9·9	Cor. decl.	20 52 54 N
Semi-d.	− 14 55			P. D.	69 7 6
App. alt. ☾'s centre	26 12 26				
Cor. T. 39 Raper H.P. 54′ 10″	+ 46 39				
T. alt. ☾'s centre	26 59 5	Sid. T. (G. noon)	H. M. S. 18 48 34·53	Obsd. alt. ☉	° ′ ″ 5 30 45 W
		Accl. 3 h. 48½ m.	+ 37·54	33 ft. T. E. 1·4′ Jan. + ·3	+ 1 42
		M. ☉'s R.A.	18 48 12·07	T. alt. -⊖-	5 32 27

A	° ′ 26 59			☉'s decl.	° ′ ″ 22 53 42 S	Eq. T	M. S. 4 23·25
L	51 30	Sec	0·205850	14·0″ × 3·9 h.	− 55	1·16 s. × 3·9 h	+ 4·52
P	69 7	Cosec	0·029510	Cor. decl.	22 52 47 S	Cor. Eq. T.	4 27·77
	147 36						
S	73 48	Cos	9·445590				
S − A	46 49	Sin	9·862827				
	H. M. S.				H. M. S.		
☾'s H.A.	− 4 50 3·4 E	Sin²	9·543777	M. T. G.	3 53 7		
☾'s R.A. + 24 h.	26 40 9·9			Long. W	0 47 29·2		
R.A. mer.	21 50 6·5	A	·40 S	M. T. Sp.	3 5 37·8		
M. ☉'s R.A.	18 48 12·1	B	·40 N	Eq. T.	− 4 27·8		
M. T. Sp.	3 0 54·4	C	·00 gives Az. N 90° E	A. T. Sp.	3 1 10	Cos	9·847263
M. T. Green.	3 48 30·0			☉'s decl.	22 52 47	Cot	0·374688
Long. in T.	0 47 35·6			Arc (1)	30° 57′ 28″ S	Cot	0·221951
Long.	11° 53′ 54″ W					T. alt. 5° 32½′	Sin 8·984840
Run	1 36 E		H. M. S.				
Long. (1)	11 52 18 W	=	0 47 29·2	Arc (2)	82 39 34 N		Cos 9·106422
				Lat.	51° 42′ 6″ N		

Position of ship = Lat. 51° 42′ N., Long. 11° 52½′ W.

As the moon was on the prime vertical when the altitude was taken, the time deduced from this observation should be absolutely correct, and the latitude by ex-meridian of the sun will also be correct without any additional work.

NOTE.—The work of correcting the moon's semidiameter and horizontal parallax is not here shown. These elements should be taken from the Nautical Almanac (p. III) of the month, where they are given for Greenwich noon, and midnight, for every day of the year. For accuracy, a correction is necessary for the number of hours from noon or midnight, and also two other small corrections—one for parallax, for the figure of the earth, and the other for moon's augmentation with increase of altitude. For sea observations these corrections can usually be made with sufficient accuracy at sight.

POSITION FROM TWO CHRONOMETER LONGITUDES BY SUN AND MOON.

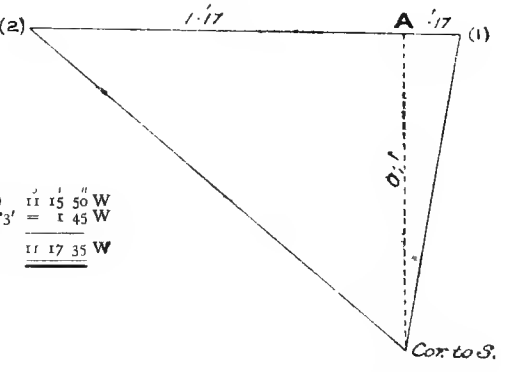
1898.—On 10th July, at about 8 h. 5 m. a.m., A.T. ship, the observed altitude of ☉'s L.L. was 35° 12′ 30″ when a chronometer showed M. T. Green. 20 h. 45 m. 40 s., and observed altitude of ☾'s U.L. was 39° 47′ 20″ W. of meridian when the chronometer showed M. T. Green. 20 h. 48 m. 48 s. Latitude by D.R. 49° N., longitude 10° 45′ W. Height of eye, 28 ft. Run in interval between observations, N. 80° E. 0·5′ = d. lat. 0·1′ N.; dep. 0·5′ E. = d. long. 0·66′ = 0′ 40″ E.

Obsd. alt. of ☉	35 12·5	☉'s Dl. 11th	22 13 1 N	Obsd. alt. of ☾	39 47 20	☾'s R.A. 21 h.	H. M. S. 0 44 6·65
Cor. Table E 28 ft.	+ 9·5	3½ h. × 19″	+ 1 2	Dip 28 ft.	− 5 13	11·2 m. × 2·0 s.	− 22·4
T. alt. −☉−	35 22	Cor. decl.	22 14 3 N	Semi-d.*	39 42 7 − 15 36	Cor. R.A.	0 43 44·25
		P. D.	67 46	App. alt.	39 26 31		
	M. S.		H. M. S.	H.P. 56′ 26½″ Cor. Raper T. 39	+ 42 25	☾'s Dl. 21 b.	10 29 20 N
Eq. T. 11th	5 5·67	Sid. T. (G. noon)	7 9 47·03			11·2 m. × 12·8″	− 2 23
h. × ·35 s.	− 1·14	Accl. 20 h. 48⅔ m.	+ 3 25·15	T. alt. ☾'s centre	40 8 56	Cor. decl.	10 26 57 N
Cor. Eq. T.	5 4·53	M. ☉'s R.A.	7 13 12·18			P. D.	79 33 3

A	35 22			A	40 9		
L	49 0	Sec	0·183057	L	49 0	Sec	0·183057
P	67 46	Cosec	0·033553	P	79 33	Cosec	0·007265
	152 8				168 42		
S	76 4	Cos	9·381643	S	84 21	Cos	8·993222
S − A	40 42	Sin	9·814313	S − A	44 12	Sin	9·843336
	H. M. S.				H. M. S.		
☉'s H.A.	4 4 30·4 E	Sin²	9·412566	☾'s H.A.	2 32 17·4 W	Sin²	9·026880
				☾'s R.A.	0 43 44·2		
A. T. Sp.	19 55 29·6						
Eq. T.	+ 5 4·5	A	·64 S	R.A. Mer.	3 16 1·6	A	1′·47 S
		B	·47 N	M. ☉'s R.A.	− 7 13 12·2	B	·30 N
M. T. Sp.	20 0 34·1						
M. T. Green.	20 45 40	C²	·17 S to W	M. T. Sp.	20 2 49·4	C²	1′·17 S to E
				M. T. G.	20 48 48		
Long. in T.	0 45 6			Long. in T.	0 45 58·6		
Longitude	11° 16′ 30″ W			Long. (1)	11° 29′ 39″ W	Cor.	1′·17 S to E
Run	40 E			Long. (2)	11 15 50 W	Cor.	·17 S to W
Long. (1)	11 15 50 W			Diff. long.	13 49	d. long.	1′·34

1′·34) 13′·8′ (10′·3
13·4
400
402

d. long. 1′·34′ : lat. 1·0′ ::
d. long. 13·8 : lat. cor. 10·3′ S



Lat. used	49 0 0 N	Long. (1)	11 15 50 W
Cor.	10 18 S	1′·17′ × 10′·3′ =	1 45 W
Lat. in	48 49 42 N	Long. in	11 17 35 W

* See note on previous page about correcting moon's semidiameter and horizontal parallax for Greenwich date.

EXAMPLES TO FIND THE ERROR AND DEVIATION OF THE COMPASS.

(1.) By Sun's Azimuth.

1903.—On 23rd June, p.m., at ship, in latitude 35° 30′ S., long. 175° 0′ E., when a chronometer which kept mean time at Greenwich showed 22 d. 16 h. 11 m. 39 s. the sun bore by compass N. 70° W.

Required the true azimuth and error of the compass by the A, B, C, Azimuth Tables; and supposing the variation to be 13° 30′ E., required the deviation of the compass for the direction of the ship's head.

	D. H. M. S.		° ′		M. S.		S. R.
M.T.G.	22 16 11 39	Decl.	23·27 S	Eq. T.	1 42·8		·54 × 7·8
Long. E	+ 11 40 0			Cor.	− 4·2		4·2 s.
M.T. ship	23 3 51 39			Cor. Eq. T.	1 38·6 − M.T		
Eq. T.	− 1 39						
A.T. ship	3 50 0	= H.A. West					
	° ′						
Lat.	35 30 S	A	·45 N				
Decl.	23 27 N	B	·51 N				
		Cor.	·96 N gives True Az. from Table C			N 52° W	
				Compass bearing		N 70° W	
				Error		18 E	
				Var.		13½ E	
				Deviation		4½ E	

(2.) By Star's Azimuth.

1903.—On 15th November, at about 3 h. 20 m. a.m., at ship, in latitude 39° 30′ S., longitude 177° 30′ E., when a chronometer (corrected) indicated mean time at Greenwich 14 d. 3 h. 30 m. the star α^2 Centauri bore by compass S. 41° E.

Required the true azimuth and error of compass by the A, B, C, Time Azimuth Tables; and supposing the variation to be 15° 30′ E., required the deviation of the compass for the direction of the ship's head.

	D. H. M. S.		H. M. S.		°
M.T.G.	14 3 30 0	Sid. T. (G. noon)	15 29 38·6		
Long. E	+ 11 50 0	Accl. 3 h. 30 m.	+ 34·5		
M.T. ship	14 15 20 0	M. ⊙'s R.A.	15 30 13·1		
M. ⊙'s R.A.	+ 15 30 13				
Sid. T. ship	− 6 50 13	or R.A. of the meridian			
✱'s R.A.	14 33 1				
✱'s H.A.	7 42 48	A	·39 S		
		B	1·96 S		
Lat.	39° 30′ S	Table C	2·35 S gives True Az.		S 28·9 E
✱ α Centauri	Table B		Compass bearing		S 41·0 E
			Error		12·1 E
			Var.		15·5 E
			Deviation		3·4 W

Note.—The H.A. of a star is found by taking the difference between the Sid. T. at ship and the star's R.A. The H.A. is east when Sid. T. is least, and west when Sid T. is best.

EXAMPLES TO FIND THE CORRECT HOUR-ANGLE AND AZIMUTH WHEN TIME IS GIVEN IN NEW ZEALAND MEAN TIME.

(1.) Sun's Azimuth.

1904.—On 24th May, at 3 h. 0 m. p.m., New Zealand mean time. Required the sun's true azimuth by the A, B, C, Azimuth Tables, at Nelson, in lat. 41° 17′ S. and long. 173° 15′ E. = 11 h. 33 m.

	D. H. M.		° ′ ″		M. S.
M. T. N.Z.	24 3 0	⊙'s Decl., 23rd	20 24 11 N	Eq. of Time	3 32·3
Long. 170° 30′ E	− 11 30	Hr. var. 29″ × 15·5 h. = cor.	+ 7 30	Hr. var. 0·18 s. × 15·5 h. = cor.	− 2·8
M. T. Green.	23 15 30	Cor. Decl.	20 31 41 N	Cor. Eq. Time	3 29·5
Long. Nelson	+ 11 33 E				
M. T. Nelson	24 3 3	Lat. 41°·3 S	A ·84 N		
Eq. of Time	+ 3½	Decl. 20·5 N	B ·51 N		
A. T. Nelson	24 3 6½	H. A. 3 h. 6 m.	C 1·35 N gives ⊙'s true Az. N 44°·7 W		

⊙'s Azimuth by Burdwood's Tables, N 44°·6 W

(2.) Sun's Azimuth.

1904.—On 23rd December, at 7 h. 0 m. p.m., New Zealand mean time. Required the sun's true azimuth by the A, B, C, Azimuth Tables, at Wellington, in lat. 41° 17′ S. and long. 174° 45′ E.

	° ′	
Long. for Standard time	172 30 E	
" Wellington	174 45 E	
Cor. for diff. of long.	2 15 = + 9 m. to N.Z. M. time	

[Note.—The Decl. and Eq. of Time may be taken out at sight with sufficient accuracy for azimuth purposes.]

	D. H. M.			
M. T. N.Z.	23 7 0			
Cor. for long.	+ 9			
M. T. at Wellington	23 7 9	Lat. 41°·3 S	A ·28 S	named S because H. A. is more than 6 h.
Eq. of Time	+ 1	Decl. 23·5 S	B ·45 S	
A. T. Wellington	23 7 10	H. A. 7 h. 10 m.	C ·73 S gives ⊙'s Az. S 61°·2 W	

⊙'s Azimuth by Burdwood's Tables, S 61·2° W

(3.) Star's Azimuth.

1904.—On 15th September, at 7 h. 30 m. p.m., New Zealand mean time, in lat. 43° 30′ S. and long. 169° 40′ E. Required the true azimuth of star α Centauri by the A, B, C, Azimuth Tables.

	O. H. M. S.		H M. S.
M. T. N.Z.	15 7 30 0	Sid. T. (Green. noon) 14th	11 29 8·8
Long. 172° 30′ E	− 11 30 0	Accl. for 20 h.	+ 3 17·1
M. T. Green.	14 20 0 0	M. ⊙'s R. A.	11 32 25·9
Long. 169° 40′ E	+ 11 18 40		
M. T. ship	15 7 18 40		
M. ⊙'s R. A.	+ 11 32 26		
Sid. T. ship	18 51 6	Lat. 43°·5 S	A ·45 N
*'s R. A.	14 33 1	α Centauri	B 1·95 S
*'s H. A.	4 18 5 W	H. A. 4 h. 18 m.	C 1·50 S gives Azimuth S 42°·6 W

True Azimuth by calculation, S 42°·55

GREAT-CIRCLE SAILING COURSES.

The initial great-circle courses between any two places on the globe comprised within the zones of latitudes 85° N. and 85° S. may be quickly determined by the aid of the A, B, and C Tables. (See rule and examples below.)

RULE.—Turn the difference of longitude between the two places into time, and consider this as the *hour-angle;* with this H.A. and the latitude of *departure* as latitude, take out the factor from Table A, and with the latitude of *destination* as declination, enter Table B. Follow the same rules as for finding and naming the azimuth, and Table C (azimuths) will give the *initial* course. Reverse the process, and we have the course at point of destination.

The following examples are taken from Norie's Epitome, so that it may be readily seen that there is no appreciable difference between the course as found by these tables and that obtained by the more rigorous and lengthy calculation which is generally used :—

Example (1).—Required the great-circle initial courses between Cape Runaway, New Zealand, in latitude 37° 31′ S., longitude 178° 1′ E., and Cape Horn, in latitude 55° 59′ S., longitude 67° 16′ W.

(1.) Lat. 37° 31′ S. Long. 178° 1′ E. } d. long. 114° 43′ = 7 h. 38 m. 52 s.
(2.) Lat. 55 59 S. Long. 67 16 W. }

H.A.	7 h. 39 m.	A	·35 S.	H.A. 7 h. 39 m.	A ·68 S.
Lat.	37½° S.	B	1·64 S.	Lat. 56° S.	B ·84 S.
Decl.	56° S.	C	1·99 S. gives Co. S. 32½° E.	Decl. 37½° S.	C 1·52 S. gives Co. S. 49½° W.

Course from Cape Runaway, S. 32½° E; or from Cape Horn, S. 49½° W.

Example (2).—Required the initial great-circle courses between Otago, in latitude 45° 47′ S., longitude 170° 45′ E., and Panama, in latitude 8° 57′ N., longitude 79° 31′ W.

(1.) Lat. 45° 47′ S. Long. 170° 45′ E. } d. long. 109° 44′ = 7 h. 18 m. 56 s.
(2.) Lat. 8 57 N. Long. 79 31 W. }

H.A.	7 h. 19 m.	A	·37 S.	H.A. 7 h. 19 m.	A ·06 N.
Lat.	45¾° S.	B	·17 N.	Lat. 9° N.	B 1·09 S.
Decl.	9° N.	C	·20 S. gives Co. S. 82° E.	Decl. 45¾° S.	C 1·03 S. gives Co. S. 44½° W.

Course from Otago, S. 82° E.; or from Panama, S. 44½° W.

Example (3).—Required the initial great-circle courses between a position off Lizard, in latitude 49° 50′ N., longitude 5° 12′ W., and 5 m. E. of Barbadoes, in latitude 13° 6′ N, longitude 59° 20′ W.

(1.) Lat. 49° 50′ N. Long. 5° 12′ W. } d. long. 54° 8′ = 3 h. 36 m. 32 s.
(2.) Lat. 13 6 N. Long. 59 20 W. }

H.A.	3 h. 36 m.	A	·86 S.	H.A. 3 h. 36 m.	A ·17 S.
Lat.	49° 50′ N.	B	·29 N.	Lat. 13° 0′ N.	B 1·46 N.
Decl.	13° N.	C	·57 S. gives Co. S. 69°·8 W.	Decl. 49° 50′ N.	C 1·29 N. gives Co. N. 38½° E.

Course from Lizard, S. 70° W.; or from Barbadoes, N. 38½° E.

EXAMPLES TO FIND THE ERROR OF COMPASS FROM BEARINGS OF THE MOON AND OF THE STAR POLARIS.

(1.) By Moon's Azimuth.

1898.—On 6th January, at about 9h. 46m. a.m., M.T. at ship, in latitude 72° N., and longitude 25° 15′ E., when a chronometer showed M.T. Green. 20h. 5m. 3s. the moon bore by compass N. 25° W. Required the moon's true bearing and the error of compass for the direction of ship's head.

	H. M. S.
M. T. Green. 5d.	20 5 3
Long. E	+ 1 41 0
M. T. Sp.	21 46 3
Sid. T. (G. noon)	19 0 24
Accel. 20h. 5m.	+ 3 18
R.A. mer.	16 49 45
☾'s R.A.	5 49 45
☾'s H.A.	11 0 0 W

	H. M. S.
☾'s R.A. 20h.	5 49 34
2 2s. × 5m. =	+ 11
Cor. R.A.	5 49 45

H.A. 11h. 0m.
Lat. 72° N
Decl. 26° N

	° ′ ″
☾'s decl. 20h	26 0 28 N
1″·86 × 5m. =	− 9
Cor. decl.	26 0 19 N

	′
A	11·5 N
B	1·88 N
C	13·38 N gives Az. N 13°·6 W

Compass bearing N 25°·0 W
Error 11°·4 E

(2.) By Star Polaris Azimuth.

1906.—On 6th February, at 10h. 30m. p.m., A.T. at ship, in latitude 25° N., longitude 35° 45′ E. Suppose ✱ Polaris bore N. 4° E. Required the error of compass for the direction of ship's head.

	H. M.
A ☉'s R.A	21 18
✱'s R.A. + (24h.)	25 25
A.T. of ✱'s mer. pass.	4 7
A.T. at ship	10 30
✱'s approximate H.A.	6 23 W

Lat. 25° N.
H.A. 6h. 23m.
Table G., p. 88
gives Az. N 1°·3 W.

Compass bearing N 4°·0 E.
Compass error 5°·3 W.

ILLUSTRATIONS TO SHOW HOW LIVES MAY BE SAVED BY THE CAREFUL OBSERVER, AND, CONVERSELY, HOW LIVES ARE OFTEN LOST.

As it has been the duty of the writer for the last few years to carefully go over all the evidences in connection with strandings, &c., on the New Zealand coast, he has been more than ever impressed with the value of keeping up regular systematic bearings and astronomical observations. Personally, he has known the comfort and benefit of doing so by several years' experience, and of late has many times noted the sad consequences of neglect to do so.

As an illustration, let us take the case of a barque which stranded in Nov., 1904, about 11 miles south of Kaipara Harbour. She was bound to Kaipara Harbour from Sydney in ballast, and at noon on 15th November, 1904, was about 143 miles from Kaipara Heads, with a fresh fair wind for her port. Towards evening (the weather apparently still fine) the barometer began to fall, and at 3 a.m. the wind had increased to gale force from W.S.W. Shortly afterwards land was seen, estimated to be 6 to 8 miles off. The land sighted was considerably to the southward of Kaipara Harbour, and the ship being in ballast it was impossible to beat off the coast to make either Kaipara or Manukau Harbours; there was therefore nothing left to be done but to run the ship on the softest spot on a lee shore. Now, had the master of this vessel been in the *habit* of getting the ship's position shortly after sunset by stellar observations, he would in all probability have been able to get a very accurate determination of the ship's position at about 7 p.m., or a little later, when only 50 miles or less from the range of Kaipara light, which he could then have steered for with confidence, and a certainty of making:

and, as it happened to be H.W. at about 2 a.m., he would have had everything in his favour for an easy run into the harbour.

Take, again, the case of the s.s. "Elingamite," which was wrecked on the outer rock of the Three Kings in November, 1902—a disaster which caused the loss of many lives. So far as we are able to gather from the evidence given at the inquiry, the weather was fine on the evening before the disaster, and in all probability the position of the ship might have been very accurately determined at about 7 p.m., when the ship was about 90 miles in advance of the noon position. Such an observation would most likely have shown which way the current was setting, and many lives would have been saved.

The third case within three years which has come before the New Zealand Courts in which a ship has been totally lost, but would in all human probability have been saved had the master taken stellar observations before dark, was that of the barque "Thistle" (2,192 tons) which was wrecked on Palmerston Island, Cook Islands, on 7th November, 1905.

At noon on 6th November observations were taken which showed that the South Point of islands bore S. 52° W. 98 miles, and north end bore S. 55° W. distant 95 miles. The ship was then on port tack, wind S.S.E. (true). The Captain then decided to go to leeward of the islands, and kept away a point. At 4 a.m. the look-out reported land on the starboard beam, and almost immediately afterwards the ship was on the reef.

From the evidence of J. Ross, A.B., who was at the wheel from 6 p.m. to 8 p.m., the sky was clear at that time, so that there is little doubt but that a position obtained by stellar observation at about 7 p.m. would have shown the master how the current was setting, and enabled him to set a safe course to go clear of all dangers.

Now, no Court of Inquiry (certainly in New Zealand) ever even asks the question as to whether a position by stellar observations has been obtained before dark, and yet there is certainly no other time in the whole twenty-four hours when the position of the ship can be so accurately and certainly determined as either shortly after sunset or shortly before sunrise. The writer has made a regular practice of taking these observations for several years of his sea life, and knows well from experience that no other observations are to be compared with them. The noon position is at best only an approximation, and should never be relied on too implicitly, for though half a dozen men may take the meridian altitude and get the *same* result they may all be several miles in error, owing to some unusual excessive refraction near the horizon. The very agreement of so many observers would only give a false confidence, which is the more dangerous as there is no opportunity with the sun observation (except when near land) of checking it, and thereby determining the error. Then, again, the *so-called* noon longitude generally depends on an observation taken at about 8 or 9 a.m., and the calculation of the time from this observation is often made with an erroneous latitude, thereby giving a wrong result; and currents, or bad steering, &c., may again combine to still further throw the position out. With the position, however, obtained by simultaneous observations of two or three stars, errors resulting from uncertainty of refraction, &c., may be eliminated. The horizon shortly after sunset is generally very clearly defined, without any glare, and the latitude and longitude are obtained at the same instant of time.

If shipowners made it compulsory for their officers to obtain the ship's position whenever possible by stellar observations at twilight, it would, I believe, be the means of saving many ships from disaster, and the saving of not a few lives.

With regard to the above remark about absence of questions in Courts of Inquiry *re* position by stellar observations, we do not wish to imply that they are in fault for neglecting to ask such questions. We consider that they are justified in this, as the problem is not given in the Board of Trade examination for the certificate of master of a foreign-going vessel, and therefore it would be unfair to bring in even a censure on the master for neglect of taking precautions about which the authorities do not compel him to know anything. It was only in 1898 that this problem was first given in the voluntary examination for extra master, and the memory of the lengthy way in which it is required to be worked in the examination-room will be quite enough to deter most men from making anything like a daily practice of such an observation after their examination is over. This method makes an interesting problem in the solving of several spherical triangles to obtain one final result, but few men, even when they have the taste for it, can afford the time in these days of rush for such lengthy calculations. To obtain confidence in the result of observations for any problem the navigator

must make more than an occasional trial of it. To encourage more frequent observations of this very important problem we would suggest that it be given in the mates' and masters' examinations, and that short and accurate methods such as have been advocated in these pages be allowed. Navigators soon become acquainted with any problem which is given in the Board of Trade examinations.

Since the loss of the three vessels just mentioned I have received the more cheering news of the probable salvation of two large steamers owing to the master, or his officers, taking stellar observations, and so being warned in time of a dangerous set by an unusually strong current. The captain of a large liner of over 7,500 tons gross register wrote to the author in March, 1906, as follows: "During my ten years of command I have always used your tables for sun and star navigation, and invariably with excellent results and great success. In one instance particularly (of which I send you the working) it saved me from a narrow escape off Lincoln Island (northern extreme Island of Paracel group). Having experienced unusually strong currents setting to westward I kept well over to Macclesfield Bank, but nevertheless I took good observations in the morning and obtained cross bearings of stars, and was able to alter my course in time. Another shipmaster expressed gratitude that these tables had taught him the value of stellar observations, as such observations had been the means of saving his ship from stranding in the Bay of Bengal."

It may not be amiss here to remind navigators that when the moon is up in the daytime observations of moon and sun will also give both latitude and longitude at the same instant of time. Reference to example on p. 117, shows that the moon may often be observed on the prime vertical when, in the winter months, the sun never comes near to it. When the sun has a high south declination, the moon, when near the full, will have a high north declination, and *vice versa*, so that in the winter months it is especially good when in this quarter for longitude, and during the summer months for latitude. This observation, however, is even less frequently taken than that of simultaneous observations of two stars, as this problem is not given even in the extra masters' examination; it also entails more work in the calculation, and the upper limb has often to be taken, which without practice is liable to be confusing. The planet Venus, too, may sometimes be utilized in the daytime. The writer has occasionally obtained the latitude from an observation of Venus when on or near the meridian, at about 9 a.m., or 3 p.m., when the usual sights were taken for longitude. Captain W. P. Dawson, R.N., of H.M. surveying-ship "Penguin," has informed him that he has sometimes observed Jupiter, Sirius, and Canopus during the daytime. This must require good eyesight and a very clear atmosphere. The approximate altitude of the planet should, of course, be calculated, and the sextant set to it; then, if the observer looks at the horizon in the direction of the meridian through a good telescope, he may see a little white speck near the horizon, which will be the reflected star. A pelorus set to the true north or south will be found helpful in directing to the spot where it should be seen.

On the back of the United States pilot chart of the North Pacific Ocean for November, 1909, published by the Hydrographic Office of the United States of America Navy Department, some very interesting experiences of stellar observations during strong daylight were given by Captain R. E. Thomas, of the British steamer "Swedish Prince." He states that on the passage from New York to the Brazils noon observations of Venus for longitude were made simultaneously with observations of the sun for latitude on fourteen dates, between September 21st and October 8th, 1906. On another occasion, while on a passage from Rio to New York, similar observations were taken on sixteen dates, between February 8th and February 26th, 1907. Using Venus and Jupiter in conjunction with the sun while on the passage from Cape San Roque to Barbadoes, in a current varying in strength and direction, he was able for a number of days to obtain four absolute positions in broad daylight during each day—viz., about 9 a.m., longitude sun, latitude Venus; about 10.30 a.m., latitude and longitude by observing Venus S.W. and sun S.E.; at noon, latitude sun, longitude Venus W.; and about 4 p.m., latitude Jupiter, longitude sun. During these days the noon longitude obtained solely by the sun could not but be considerably in error. In concluding he says: "I may add that Jupiter, though not so easily observed as Venus, is still worthy of a place as an observable object by daylight, and one that will repay the patience and practice which its successful observing calls for."

EXAMPLE OF FINDING THE ERROR OF CHRONOMETER BY OBSERVATIONS IN ARTIFICIAL HORIZON,

SHOWING THE USE OF TABLE D IN WORKING OUT SEVERAL OBSERVATIONS SEPARATELY.

1898.—On 16th April, at about 7 h. 10 m. a.m., M.T. at place. Suppose the following observations to have been taken at Observation Spot, Suez Dock. Index error of sextant − 0′ 34″. Lat. 29° 56′ 3″ N., long. 32° 33′ 12″ E. = 2 h. 10 m. 12·8 s.

Approx. times at Green. by chron.	H. M. S.
	16 59 33
	16 59 57·5
	17 0 23
	17 0 47
	17 1 11
	17 1 35·5
	17 2 0

Obsd. alt. ☉	° ′ ″	Alt. diff. ′ ″
(1)	39 38 40	
(2)	39 49 20	10 40
(3)	40 0 20	11 0
(4)	40 10 50	10 30
(5)	40 21 10	10 20
(6)	40 31 40	10 30
(7)	40 43 20	11 40

Required the error of chronometer

	O. H. M. S.
M. T. G.	5 17 0 47
	24 0 0
From noon 6th	7 h.

	° ′ ″
☉'s Dl.	10 13 50 N
53′·1″ × 7 h.	6 12 S
Cor. Dl.	10 7 38 N
P. D.	79 52 22

	M. S.
Eq. T.	0 16·65
0·6 s. × 7 h.	− 4·2
Cor. E. T.	0 12·45

No. 4.—Middle Sight

	° ′ ″
Alt. ☉	40 10 50
I. E.	− 0 34
2	40 10 16
App. lat.	20 5 8
Ref. & par.	− 2 30
	20 2 38
S. D.	+ 15 57
T. alt. −☉−	20 18 35

	° ′ ″
A	20 18 35
L	29 56 3
P	79 52 22
	130 7 0
S	65 3 30
S − A	44 44 55

Sec	0·062182
Cosec	0·006820
Cos	9·624999
Sin	9·847572
Sin²	9·541573

Table D.

L. 30°, Az. 90°, gives 4·62 s. to 1′ alt. ÷ 2 = 2·31 s., because altitude is doubled in artificial horizon.

	H. M. S.
H.A.	4 49 12·3
A. T. Sp.	19 10 47·7
Eq. T.	− 12·4
M. T. Sp.	19 10 35·3
Long. E −	2 10 12·8
M. T. G.	17 0 22·5
Chron. (4)	17 0 47·0
Chron. fast	0 24·5

A	·19 S
B	·19 N
C	·00 gives Az. 90°

	H. M. S.
M. T. G. (No. 4)	17 0 22·5
2·31 s. × 10½′	− 24·2
M. T. G. (No. 3)	16 59 58·3
Chron.	17 0 23·0
Chron. fast	0 24·7

	H. M. S.
M. T. G. (No. 3)	16 59 58·3
2·31 s. × 11′	− 25·4
M. T. G. (No. 2)	16 59 32·9
Chron.	16 59 57·5
Chron. fast	0 24·6

	H. M. S.
M. T. G. (No. 2)	16 59 32·9
2·31 s. × 10⅔′	− 24·6
M. T. G. (No. 1)	16 59 8·3
Chron.	16 59 33·0
Chron. fast	0 24·7

	H. M. S.
M. T. G. (No. 4)	17 0 22·5
2·31 s. × 10⅓′	+ 23·9
M. T. G. (No. 5)	17 0 46·4
Chron.	17 1 11·0
Chron. fast	0 24·6

	H. M. S.
M. T. G. (No. 5)	17 0 46·4
2·31 s. × 10½′	+ 24·2
M. T. G. (No. 6)	17 1 10·6
Chron.	17 1 35·5
Chron. fast	0 24·9

	H. M. S.
M. T. G. (No. 6)	17 1 10·6
2·31 s. × 11⅔′	+ 27
M. T. G. (No. 7)	17 1 37·6
Chron.	17 2 0·0
Chron. fast	0 22·4

It is evident that the last observation was in error, probably owing to the altitude having been either read off or put down incorrectly. It is therefore rejected, and a mean taken of the other six.

Results.

Chron. fast	S
	24·7
	24·6
	24·7
	24·6
	24·9
Mean	24·66

Observations with artificial horizon are not so much needed as they were twenty or thirty years ago, as of late years time signals giving G.M.T. have been established at most places of importance. Still, it is well to be independent of such aids. In the first place, they are not *always* reliable, and, secondly, in these days of steam and rush a vessel sometimes arrives at and leaves a port again, as at Port Said, before the time when the signal is given; and there are still many places where such aids are not to be found. The writer, when second officer, used sometimes to check the chronometer by observations of stars in the quicksilver, in his middle watch at night, when tied up in the Suez Canal or at anchor in the Bitter Lakes. Results were very satisfactory, as proved by observations east and west of the meridian, which did not generally differ more than 1 s. from one other.

He never found it possible to get such observations of the *sun* on board ship, as in the daytime so many people are moving about; but in a large ship at anchor in smooth water observations in the quicksilver can often be taken at night, when all on board except the observer and time-taker are in bed, and everything is quiet.

REMARKS ON THE VALUE OF EQUAL ALTITUDES BY SEA.

We would draw attention here to the value of the short equal-altitude problem, as this method of obtaining the longitude, though very simple and useful, is seldom noticed by nautical writers. The problem is more especially useful in the case of stars, owing to there being no appreciable change in a star's declination, and because suitable ones can generally be found in any latitude. Even on dark nights a very fair longitude can generally be obtained, errors of altitude eliminating one another in a similar way as when stars are observed for latitude north and south of the meridian. An equally good result is obtained if *both* altitudes are observed the same amount too great, or too small, as if they had both been correct, and the problem is so simple that it takes very little longer than to get the latitude by meridian altitude—we mean, of course, when within the limits where correction for change of latitude and declination are not necessary.

The writer has often taken these equal altitudes about the same time as other observations have been taken—sometimes before daylight with an indifferent horizon, and at others with a good horizon a little before sunrise or after sunset—and they have nearly always agreed splendidly with the star-position longitude obtained by double altitude.

The navigator should not, however, use this method beyond its proper limits, and when the sun is observed it will seldom be useful except in the tropics, and then principally when running nearly due east or west, as on passages from Penang to Ceylon and Aden. When running due east or west *no* correction of altitude or time is required for ship's change of position, as she would change her longitude only by the portion of time which she gains or loses on the sun in the interval. Also, when the body observed bears east or west, *no* correction is required for several miles' change of latitude to the north or south; therefore it follows that when the observed body is near the prime vertical, and the change of latitude is small, it is not practically necessary to make any corrections for change of ship's position. Table 29 in Raper gives the hour-angle and altitude of a body on the prime vertical; and most other epitomes also have a table at any rate for giving the hour-angle of same, which is always useful for showing the best time to observe for longitude.

(1.) The Computation (Raper, p. 801).

Take the mean of a.m. and p.m. times by chronometer: this, when the ship does not change her latitude, is the time by chronometer of *apparent* noon; when the latitude changes, this time is the time of approximate noon. Apply chronometer error and equation of time (p. II., N.A.), which will then show the A.T.G.; the difference between that and the apparent noon at ship being the longitude in time.

(2.) Correction for Change of Latitude.

With half the interval as an hour-angle, compute the azimuth. To the log. sine of half the D. lat. made good, add the log. sec. of the lat. and the log. cotan. of the azimuth; the sum, rejecting tens, is the log. sine of the correction *in time*.

When the ship has approached the sun or star in the interval, *subtract* this time from the above mean; when she has receded from the sun, *add* it. The result is the time by chronometer at apparent noon.

Note.—When the observed body is within 10° or so of meridian, the D. lat. made good in the interval may be added or subtracted from the altitude according as the ship has approached or receded from the sun, instead of going through the longer but more accurate computation.

Longitude by Equal Altitudes of the Sun.

Example 1.—*Ship steering nearly East or West.*

In lat. by D.R. 6° N. and ⊙'s decl. 5° N. Equal altitudes of the sun were taken when chronometer times, a.m. and p.m., showed respectively 18 h. 10 m. 36 s. and 18 h. 42 m. 52 s. Chronometer fast on G.M.T. 10 m. 6 s. Required the longitude.

	H. M. S.
Chron. time a.m.	18 10 36
Chron. time p.m	18 42 52
	2) 36 53 28
Middle time by chron.	18 26 44
Chron. fast	10 6
M. T. G. of Sp. A. noon	18 16 38
Eq. T.	− 3 34
A. T. G. of Sp. A. noon	18 13 4
A. T. Sp.	24 0 0
Long. in. time	5 46 56
Longitude	86° 44′ 0″ E

EXAMPLE 2.—*Where Ship has changed her Latitude between Sights.*

Using the preceding example, with course made good N. 73° E. 7 m. = D. lat. 2′.

	H. M. S.				
Half intl. as H.A.	0 16 8	,	Half D. lat.	1·0′	Sin 6·464
Lat. 6° N	Table A	1·50 S	Lat.	6°	Sec 0·002
Decl. 5° N	„ B	1·25 N	Az.	76°	Cot 9·397
Az. S 76°		·25 S	15″ = 1 s. to add.		Sin 5·863

	H. M. S.
Middle time of observations by chron.	18 26 44
Correction for change of latitude	+ 1
	18 26 45

Here the sun is to the southward and the course is to the northward, or the ship has *receded* from the sun.

As the change in ☉'s decl. never exceeds 1′ in an hour, the correction for this may be disregarded when observations are taken within a few minutes of noon.

EXAMPLE 3.—*Longitude by Equal Altitudes of a Star near the Meridian.*

* 1898.—On 6th September, at about 5 h. 26 m. and 5 h. 36 m. a.m., A.T. at ship, in lat. by D.R. 9° 30′ N., long. 63° E. Observed equal altitudes of ✳ Aldebaran to the northward at 13 h. 49 m. 5 s. and 13 h. 59 m. 5 s. by chronometer which was fast of G.M.T. 37 m. 36 s. Run in interval between observations, S. 75° E. 2 m. = D. lat. 0·5′.

	H. M. S.
1st chron. time	13 49 5
2nd chron. time	13 59 5
	2)27 48 10
Chron. time of transit	13 54 5
Chron. error	− 37 36
M. T. G. of transit	13 16 29
Sid. T. (G. noon), 5th	10 58 27·2
Accl. for 13 h. 16½ m.	+ 2 10·8
Sid. T. at Green.	24 17 7·0
Sid. T. at Sp. (✳'s R.A.)	28 30 8
Long. in time	4 13 1 = 63° 15′ 15″ E

In this example, as the star was only 10° from the meridian, and the ship had receded from the star, 0′ 30″ less altitude was set to the sextant for the second observation.

There is no more work here than with the sun, as there is no equation of time to apply, and it is even easier to correct the sidereal time than the equation of time.

The writer's usual morning double altitude was taken 3 m. before this first sight, by Saturn and Sirius, both east of meridian, the resultant giving longitude, when brought up to the same time, within 1′ of the equal-altitude longitude. He has taken several with equally good results, though in this case it was probably accidental that so near an agreement with the other observations was obtained, as better results might have been expected with a longer interval of time, when the star would have been nearer the prime vertical; daylight, however, prevented this.

It is best to choose stars with declination nearly the same as latitude, or else of the *same* name and the declination less than the latitude. If the declination is greater than the latitude, as in the last example, it does not come to the prime vertical at all; neither does it if the declination and latitude are of contrary names. With latitude and declination of *same* name, when the numbers corresponding to the hour-angles in Tables A and B nearly agree is always a good time. For instance, in latitude 46° N., at hour-angle 0 h. 20 m., with ✳ Capella, the numbers in Tables A and B exactly agree, both being 11·8′; Capella, therefore, with that latitude and hour-angle would be exactly on the prime vertical.

The following example (on p. 128) will show how a star may sometimes be observed almost on the prime vertical to within 2 or 3 minutes of its meridian passage, or at any time within 2 or 3 hours of its transit.

* The actual observations for this and the following example were taken in 1885, but for the sake of uniformity are here worked for the year 1898.

EXAMPLE 4.—*Longitude by Equal Altitudes of a Star nearly East or West.*

1898.—Colombo towards Aden. On 13th October, at 6 h. 24 m. and 6 h. 34 m. p.m. (ship time). Observed equal altitudes of ✶ Altair at 2 h. 16 m. 55 s. and 2 h. 28 m. 24 s. by a chronometer which was fast of G.M.T. 39 m. 4 s. Star's azimuth at 1st obsn., S. 80° E. Lat. by meridian altitude, 8° 46′ N. Run in interval, N. 80° W., distance 2½ m.

	H. M. S.
1st chron. time	2 16 55
2nd chron. time	2 28 24
	2) 4 45 19
Chron. time of transit	2 22 39·5
Chron. error	− 39 4
M.T.G. of transit	1 43 35·5
Sid. T. (G. noon)	13 28 16·3
Accl. for 1 h. 43½ m.	+ 17
Sid. T. at Green.	15 12 8·8
Sid. T. at Sp. (✶'s R.A.)	19 45 51·6
Long. in time	4 33 42·8 = long. 68° 25′ 42″ E

Equal altitudes of this star were taken in the twilight for three or four evenings running. A few miles change of ship's position N. or S. in this case would not have affected the longitude 1′.

The following example gives the position of ship, latitude by ex-meridian (with azimuth 45°), and longitude from equal altitude observations. The problem is also plotted on the chart, and the same result obtained.

POSITION OF SHIP BY SHORT EQUAL ALTITUDE OBSERVATIONS OF SUN.

1898.—On March 20th, about noon, approximate position of ship on Equator in longitude 75° E. Observed alt. of ⊙'s L.L. was 89° 20′ S.E. when a chronometer indicated M.T.G. 19 d. 19 h. 6 m. 9 s., and again (p.m.) the observed alt. of ⊙'s L.L. was 89° 20′ S.W. when chronometer indicated M.T.G. 19 d. 19 h. 9 m. 1 s. Course and distance run between the observations west 0½m. Height of eye 40 ft.

Required position of the ship at apparent noon.

	D. H. M. S.		M. S.		° ′
M.T.G. (a.m.)	19 19 6 9	Interval	2 52	Obsd. alt.	89 20 S[d].
M.T.G. (p.m.)	19 9 1	Run W	− 2	Cor. (p. 87)	+ 10
	2) 38 15 10		2) 2 50	True alt.	89 30
Middle time by Chron.	19 7 35	H. A.	1 25		
Eq. of time	− 7 35				
A.T.G.	19 0 0			Hr. var.	″ hrs. 59·3 × 5
A.T. Sp.	24 0 0				296·5
		Decl.	° ′ ″ 0 1 57 S		−
Long. in time	5 0 0		4 57 S		4 56·5
Longitude	75 0 0 E	Cor. decl.	0 6 54 S		

	M. S.	*Var.*
Eq. T.	7 31·4	s. hrs.
Cor.	3·7	·75 × 5
Cor. eq. T.	7 35·1	3·75

ARC (2) BY DIRECT CALCULATION.

Az.	45° 6′	Cos	9·8487
Alt.	89° 30′	Cot	7·9409
Arc (2)	0° 21′ 11″	Tan.*	7·7896

FOR AZIMUTH.

	M. S.		
H.A.	1 25	Sin	7·791
Dl.	0° 6′ 54″	Cos	0·000
Alt.	89° 30′	Sec	2·059
Az.	45° 6′	Sin	9·850

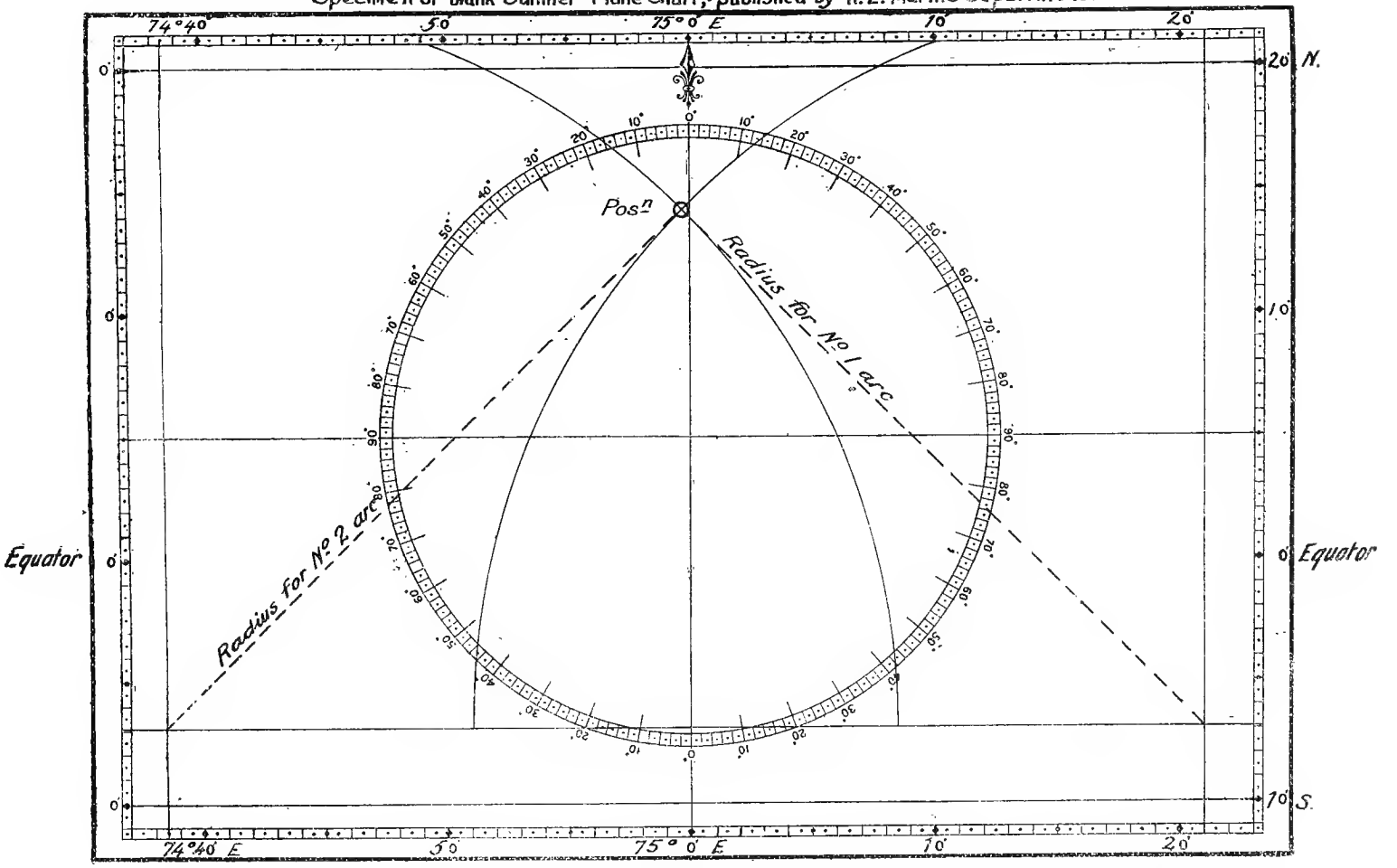
FOR REDUCTION.†

		° ′
Az. 45·1° S	Arc cor.	− 8·8
Alt. 89 30′ S	Z.D.	0 30·0 N
	Arc (2)	0 21·2 N
	″ (1) decl.	0 6·9 S
	Lat.	0 14·3 N

* As small tangents and small sines are practically the same, this arc is most conveniently taken from the table of small sines.

† By Blackburne's and Westland's Ex-meridian Tables.

Specimen of blank "Sumner" Plane Chart, published by N.Z. Marine Department.



The accompanying chartlet gives a good illustration of the "Sumner" principle in connection with this problem without any logarithmic calculations for H.A., azimuth, or reduction.

We are indebted for this method to my old friend Captain T. S. Angus, Nautical Inspector for the P. and O. S. N. Company, one of the keenest and most enthusiastic navigators I ever met. The method as stated in Admiral Sir Purey Custs's excellent little book "Sumner's Method" is as follows, viz.: Observe an altitude while the azimuth is yet large, and as soon as the Z.D. is small enough to be conveniently measured on the chart with a pair of dividers. Plot the geographical position of the sun (lat.=decl., long.=G.A.T.), and from this position as centre sweep an arc with Z.D. as radius. This is a position-line. Wait until the azimuth has sufficiently changed to give a good cut, and repeat the operation, the intersection gives the position at once without any further calculation.

The following figures give all that is necessary for plotting on the chart.

Lat. (decl.)	° ′ 0 6·9 S	1st obsn. A.T.G.	H. M. S. 16 58 34 W or	2nd obsn.	H. M. S. 19 1 26 W or
Z.D.	0 30 as radius		5 1 26 E		4 58 34 E
		Long.	75 21 30 E	Long.	74° 38′ 30″ E
		Run west	30 W		
		Long. at time of 2nd obsn.	75 21 0 E		

REMARKS ON EX-MERIDIAN AND MERIDIAN ALTITUDES.

Although we have at the present day quite a number of special very useful ex-meridian tables, apart from the standard navigational epitomes, we would here remind those who use Raper that there are tables in that epitome which make very short work of this problem when within the ordinary ex-meridian limits, and the limits of the sun's declination. When within the tropics these tables may also be used for stars of any declination up to 62° N. or S., by using the declination as latitude, and *vice versa*. The following examples will illustrate this:—

EXAMPLE 1.—In lat. by D.R. 10° N., T. alt. of ✳ α Crucis 16° 10′, hour-angle of star 1 h. 10 m. Required the reduction to meridian.

H.A. 1 h. 10 m.				
Lat. 10° N. } as decl. }	decl. 62° 35′ S. } as lat. }	Table 7a { 1 h. 10 m.	Log 9·978 Sin² 8·364	
		° ′ ″		
	Reduction	1 15 34	Sine	8·342
	True reduction	1 15 19		

EXAMPLE 2.—In lat. by D.R. 23° 30′ S., T. alt. of ✳ α Crucis 50° 53′, hour-angle 0 h. 10 m. Required the reduction to meridian.

H.A. 0 h. 10 m.				
Lat. 23° 30′ S. } as decl. }	decl. 62° 35′ S. } as lat. }	Table 7a { 0 h. 10 m.	Log. 0·127 Sin² 6·678	
	Reduction 2′ 12″		Sine	6·805

In the first example the error from the calculated reduction by Raper's table only amounted to 15″ with no error in the second, although the first example was outside the limits of the ex-meridian tables of Brent, Walter, and Williams, which tables until lately were considered to have exceptional limits, especially on account of comprising declination limits up to 70°.

The tables, however, at the end of this book are available for any latitude, or declination from Pole to Pole, and the time-limits of the first example might have been extended for another 50 min. without making more than about ½′ of error in the reduction. See limits on p. 146. The larger ex-meridian tables by Blackburn Westland,* which are published in another volume, give still more extensive limits, sometimes as much as 3 hours from the meridian and 45° in azimuth. An example of the latter is given on p. 128 of this work with an altitude of 89½°. In this example the hour-angle was accurately determined by equal altitudes close

*Tables for Azimuth, Great-circle Sailing, and Reduction to the Meridian. Price 7s.6d. Agents in United Kingdom: James Brown and Son, 52-56 Darnley Street, Glasgow. Marine Department, N.Z. Government, Wellington, New Zealand.

to the meridian, otherwise this latitude by ex-meridian would only be of value as giving a latitude on the meridian of the D.R. longitude, and the position-line or circle of altitude at right angles to the bearing of the object, to be used in conjunction with another observation. Taken as a single observation 4 sec. of error in the time would make 1′ of error in the latitude. (See Table M, pp. 150 and 151.)

Raper warns that when the number of minutes of arc in the reduction exceeds the number of minutes of time from the meridian it is proper to refer to Table 48 of that work to ascertain if it is necessary to employ the *second reduction*. It should be remembered, however, that even when the second reduction is employed, if the body has a large bearing from the meridian, the results may be considerably in error, as the formula used for these reduction tables only gives a correct result when the azimuth is small, and this must be borne in mind when using most of the formulæ given in navigation books for the reduction to the meridian.

Stars with high declinations are especially valuable for ex-meridian observations, and in high latitudes it is best to choose circumpolar stars, near the meridian *below* the Pole, as these stars change very slowly both in altitude and azimuth, and consequently errors in time only produce small errors in the resulting latitude. The amount of error due to 4 sec. of time is seen at a glance from Table M, pp. 150 and 151. It was the recognition of the great value of these stars for both latitude and azimuth that induced the writer to calculate the actual true reduction and azimuth for seventeen of the brightest circumpolar stars up to 1 h. 15 m. from the meridian at the *inferior* transit. These tables make it almost as easy to determine the latitude by ex-meridian as by the meridian altitude when within the limits of the table, and also to set the sextant to the approximate altitude, which is a great advantage when taking twilight stars. The writer has been urged to calculate the reduction and azimuth in the same way for the bright stars when near the meridian at the *superior* transit. The work for this is already well advanced, and will probably be ready when the next edition of the reduction tables are called for. High-declination stars are also preferable for observations of the meridian altitude, as a few minutes will then generally elapse without any appreciable change of altitude, both before and after meridian passage; and it is a good plan to take several observations—say, 5m. before to 5m. after meridian passage—unclamping the index each time, and to take the *mean* of these observations for meridian altitude. This plan is far preferable with stellar observations for latitude (except when altitude is very high) to that which is so often adopted of watching for the star beginning to fall.

It is necessary to caution against this prevailing plan (in these days of rapid steam navigation) even with the sun, as by so doing the observation is sometimes taken 10m. or more after *noon*, and at others a few minutes before noon. This was brought prominently to the writer's notice many years ago, when second officer of a new mail-steamer. He made it a practice always to correct his watch and the ship clock before noon by comparison with chronometer and longitude applied. On one occasion when proceeding due south off Cape Finisterre, in a winter month, the captain and a couple of officers were observing for the meridian altitude. The writer reported that it was noon when his watch came round to the hour, but the captain said he did not make it so, and the sun was still rising; we all therefore remained aft by compulsion until the captain made the sun to *dip*, at about 10m. after noon, and the writer was wrongly and thoughtlessly blamed for the clock being in error. In this particular case the ship was steaming directly towards the sun at about 14 knots an hour, and by this change of position, had the sun been stationary, the altitude would have increased 14″ in 1 m. of time, or 70″ in 5 m. of time, and had the *ship* been stationary the sun would have only dipped 0′ 36″ in that time; therefore the altitude would have increased to observer 0′ 34″. This would be about the time when the maximum altitude would be reached, but the knowledge of this is not of much practical value, and no observer at sea could detect it with the sextant, as there would barely be 1″ change in altitude between 4 m. and 6 m. after noon, and only 5″ between the noon altitude and 10 m. after. But at 10 m. after noon the altitude would have been about 40″ less than at 5 m. after noon, and, consequently, if the sea were moderately smooth the observer would probably detect that the sun was dipping. The sun's change of declination in 10 m. would only amount to 2″, and is not therefore taken into account.

If the clock had then been put back, and bearings of the land had been obtained, the supposed meridian altitude would have given a latitude 2·4′ N. of that by bearings; or if the time had been taken by chronometer, and the observation worked out as an ex-meridian, it would be found that a correction of 2·4′ was required to be added to the altitude. Should the observation be taken of a high-declination star, such as α Crucis, anywhere in the tropics, either north or south of the Equator, the natural fall of altitude in 10m. would be less than 2½′ if latitude and declination were of *same* name, and barely 1½′ with latitude and

declination of *contrary* name. When the meridian altitude of the moon is observed for latitude the moon's change of declination must also be remembered, which is very rapid when near the Equator—occasionally over 17′ an hour. Lecky, on p. 371 of "Wrinkles" (ninth edition), states that the hourly change of the moon's declination when crossing the Equator is 18′; if the change is ever as great as this it must be only on very rare occasions. The greatest change that has come under the writer's notice was in August 31st, 1894, when it amounted to 17·3′ change in the hour. Taking three years at random, and going carefully through the Nautical Almanac, the writer could find no hourly change greater than 15½′, and the average hourly change when the moon was crossing the Equator was under 12½′ in the three years.

Mr. C. Westland has drawn the writer's attention to a method of finding the hour-angle of maximum altitude by the help of the A & B Tables, as follows:—

Assume reduction at 1 m. from meridian $= \frac{15'}{2\,[A \pm B]}$ (Formula of Ex-meridian Table No. 2.)

Then H.A. of maximum altitude is given in minutes of time by $\frac{K\,[A \pm B]}{15'}$ and since 1 m. of time is equal to 15′ of arc it follows that the numerator of this fraction is the required H.A. expressed in arc.

Rule.—Express the difference in motion of lat. ± decl. (that is K) in minutes of arc per minutes of time, and multiply it by A ± B for 1 m. To reduce to time subtract one third and move decimal point one place to left.

Example.—Using data above, and disregarding change of decl. (as it only amounts to 0·2″ in 1 m. of time), K = 14″ = 0·233′.

Lat.	43° N	A	213′·7 S
Decl.	23 S	B	97′·3 S
		C	311′·0 × K 0′·233 = 72′·46 = 4·83 m. = 4 m. 50 s. Required H.A. of maximum altitude.
			Subt. ⅓ 24′·15
			48′·31

This method is considerably shorter and easier to remember than the methods usually given in navigational books.

A FEW NAVIGATIONAL NOTES AND CAUTIONS.

EXCEPTIONAL EXCESSIVE REFRACTION NEAR THE HORIZON.*

It has often been pointed out in text-books of navigation and elsewhere that altitudes observed at sea are subject to error when peculiar atmospheric conditions operate to produce an extraordinary deflection of the ray of light from the horizon, and thus to make the actual angle of dip vary from its tabulated value. It is believed that attention can not be too frequently directed to this important subject, for the reason that there are undoubtedly many navigators who do not realize the magnitude of the error that may be involved: some have the impression that this error is such as to throw the results out by no more than a mile or so, and hence may be neglected for all practical purposes; others, while knowing that in the Red Sea and other special localities the error is to be guarded against, do not consider that it need ordinarily be feared by the navigator. It can be demonstrated that this error may attain a value so great as to jeopardize a vessel, even if a very large margin be allowed for inaccuracy of the sights, and that the conditions under which it is produced are such that it may occur in any region of the ocean.

It has been seen that the conditions necessary to produce extraordinary deflections of the rays require that the atmosphere shall arrange itself in a series of horizontal strata of uniformly varying density. It follows, therefore, that the mere difference in temperature between air and water is not sufficient in itself to produce the error, and that any cause that interferes with the formation of strata will prevent the occurrence of the deflection. As wind, by keeping the air in motion, renders the conditions unfavourable for the existence of layers of unequal density, it follows that a light breeze will,

* Extract from a publication issued by the Bureau of Equipment, Department of the Navy, Washington. D.C.; by Lieutenant G. W. Logan, U.S. Navy.

in general, greatly reduce the error, and that a strong one will effectually prevent it. Hence it is that the maximum bending of rays is to be expected in calm weather. It seems probable that the stratification is more likely to be disturbed when the air is colder than the sea than in the opposite condition, since the heavier particles are then above the lighter, and the atmosphere is in a state of unstable equilibrium that may be easily disturbed.

Both theory and experience show that the higher the eye of the observer is placed above sea-level the smaller are the deflections from the causes under consideration. It is therefore well, especially when there is reason to suspect the conditions that produce abnormal deflections, to observe altitudes from the highest available position.

One of the most dangerous features of this error is that there is no satisfactory method of arriving at a correct estimate of its amount. If the conditions with which it is necessary to deal were fixed in their nature, such, for example, as the mean atmospheric conditions for which the ordinary dip-table is computed, it would be a simple matter to arrive, either by theory or experiment, at the amount of the deflection. But the elements of the problem can not, in their nature, be known. For instance, the conditions of temperature and wind at a distance of several miles from the observer, which can not be determined at the ship, have an important bearing on the solution; so also with the amount of moisture in the air, which is doubtless a material factor. The navigator may, however, recognize the existence of the disturbing conditions and the probable direction in which the disturbance will affect the results of his observations, and with this knowledge he must make ample allowance for possible errors.

From a very large number of recorded instances of abnormal deflections of the rays of light from the horizon, due to inequality of temperature between sea and air, a few will be chosen to illustrate the possible magnitude of this error.

It is related that on one of Captain Cook's voyages the meridian altitude of the sun was being taken when a light snow-squall came on. The horizon and sun remaining visible, the altitude shown by the sextant had almost instantly to be altered 32′ to maintain contact, the horizon having appeared to fall by that amount when the air surrounding the observers was cooled by the snow-squall. At the same time a distant mountain-peak, which before had stood well above the horizon, almost disappeared from view. Both of these effects vanished with the passing of the squall, the measured altitude resuming its former value and the peak rising again above the horizon. Even if we are inclined to doubt the instruments of those times, and therefore the exactness of the observed difference, this account is of interest in showing at how early a day the presence of this error was recognized in navigation.

According to Raper, Mr. Fisher observed in the Arctic regions a variation of 18′ in the place of the horizon.

The late Captain Lecky, in his "Wrinkles," states that on a clear day in midwinter, off the coast of Long Island, five observers at noon closely agreed upon an altitude which gave a certain latitude; in less than two hours afterwards the land was sighted, and the latitude brought forward from the meridian altitude was found to be 14′ in error.

Lieutenant Koss and Ensign Thun-Hohenstein, of the Austrian Navy, while conducting observations near Pola for finding the variation in the dip of the horizon, observed on a quiet day a rise of the apparent horizon above its computed position of 8′ 47″ at a height of 50 ft., and of 9′ 23″ at a height of 33 ft. above water.

Of the numerous instances that might be cited of extraordinary errors in the results given by astronomical sights in the Red Sea (so extraordinary as to have given rise to an erroneous belief as to the currents existing in that body of water), it may be mentioned briefly that Lieutenant Marshall, U.S. Navy, of the U.S.S. "Detroit," found errors of position from 12′ to 18′ arising from sights of the sun; Captain Nedden, of the s.s. "Madeline," found the latitude by observation to differ 10 miles from the correct one, and images of islands to be greatly distorted; and Captain Lecky discovered the positions of certain islands to be apparently 7 to 8 miles in error in one direction from morning sights, and a similar amount in error in the opposite direction from afternoon sights.

A similar instance of error in the region of the Gulf Stream was reported by Lieutenant-Commander W. L. Rodgers, U.S. Navy, of the U.S.S. "Lancaster," two lines of position from the sun intersecting at about 7 miles to the south-east of the ship's true position, and two from stars intersecting at a like distance in the opposite direction, the direction of the error in each case according with that which was to be expected from the observed differences in temperature of air and water.

As a result of what has been set forth, the following brief summary may be given for the guidance of navigators:—

(*a.*) The inaccuracy of tables showing the dip and the visibility of objects should always be suspected when there is a marked difference between the temperature of the air and that of the sea-water.

(*b.*) The errors will be largest in calm weather and when the eye is not far elevated above the sea, and will decrease as the wind increases and the eye is raised.

(*c.*) When the air is warmer than the water, the visible horizon is raised above its normal position; the altitude corrected by the ordinary dip-table will be too small, and the resulting Sumner line will be farther from the observed body than the true line. An object will be sighted from a greater distance than usual.

(*d.*) When the water is warmer than the air, the visible horizon is lowered below its normal position; the altitude corrected by the ordinary dip-table will be too large, and the resulting Sumner line will be nearer the observed body than the true line. An object will be sighted from a less distance than usual.

A little more than a year before the time of writing this a very well authenticated case of undoubted excessive refraction was brought to the notice of the writer by an old pupil (Captain W. H. Sweny), then commanding the P. and O. s.s. "Mooltan." At about 6 p.m. on April 11th, 1910, he took observations of four different stars for a position—viz., Procyon (ex-meridian) to northward, Rigel to north-westward, Canopus to south-westward, and β Centauri to south-eastward, to cross with one another. The chief officer took an ex-meridian of Pollux to northward, and Rigel and β Centauri for a cross. Shortly afterwards the fourth officer took Procyon, Canopus, β Centauri, and Jupiter to eastward. Captain Sweny first sent the writer his own observations, asking him to work them out and let him know what be made the resulting position. This was done, and when the captain afterwards sent the results of his work both positions were in agreement and evidently not more than about 1′ in error in either latitude or longitude. The captain also sent the worked-out observations of the other two officers, and from all these observations the writer was able to deduce fairly accurate separate positions, and it was evident from these observations that refraction was excessive all round the horizon, but greatest to the northward, where it was about 11·0′, and in other parts of the horizon averaging about 6¾′, the altitudes being smaller by these amounts than they should have been by allowing the usual tabular corrections The height of eye when these observations were taken was 50 ft. If the captain had been satisfied with the ex-meridian observations of Procyon and Pollux, and the longitude of β Centauri, he would have been 11′ or 12′ out in the latitude and 33′ out in the longitude. By using the observations intelligently he was practically correct in his position, and made Rottnest Light nearly ahead at 2 a.m. His position at the time was about 30° 4′ S. and 113° 47′ E.

The above related experiences, though undoubtedly *very exceptional*, should tend to warn navigators not to trust too implicitly even in daylight to observations taken on one side *only* of the meridian, or prime vertical; for though such excessive refraction is *very rare*, and may not be experienced in the lifetime of a frequent observer, it is probable that such amounts as 2′ ,difference from the tabulated value of refraction is not uncommon.

EFFECT OF ALTITUDE ERRORS.

With a.m. sights too great an altitude will place a ship to eastward of true position, and *vice versa* with p.m. sights and too small an altitude. The amount of error in longitude or time due to 1′ error of altitude is shown in Table D.

OBSERVATIONS IN ARTIFICIAL HORIZON.

In correcting the altitude taken in artificial horizon, *first* apply index error, then halve the altitude after which apply the other corrections—viz., refraction, parallax, and semidiameter.

When the lower limb is taken with a.m. sights the suns appear to be separating, and when the upper limb is taken the suns appear to be closing in on one another. *Vice versa* with p.m. sights.

NUMBER OF FIGURES TO USE WITH LOGARITHMS.

Using more than four figures of logarithms in working any of the sailings is generally a waste of figures; as also in working an altitude or time azimuth or the time when hour-angle is less than 2 hours.

In Bowditch's "American Practical Navigator" not more than five figures are given in any of the tables, and the work is thereby much facilitated.

CORRECTIONS OF SUN'S DECLINATION AND EQUATION OF TIME.

For ordinary sea practice it is generally useless precision when correcting the sun's declination to take out the hourly variation to decimals of a second; also, one place of decimal is amply sufficient when correcting the equation of time.

CORRECTION OF A PLANET'S R.A. AND DECL.

The R.A. and decl. of a planet may often be quickly corrected by the aid of the traverse-table used as a proportional table. The following example will illustrate this:—

1898.—30th August; M. T. G. 9 h. 36 m. Required the corrections for R.A. and decl. Daily change of R.A. was 236·3 s., and of decl. 28·8′.

To find correction for R.A. due to 9·6 h. from noon: Add a cipher to 24 h., then with 240 in dist. column look out the nearest number abreast it in either the dep. or d. lat. column. This will be found at 10° in d. lat. column—viz., 236·4. Having added a cipher to 24 h. the decimal point in 9·6 h. must be removed one figure to the right; then look out the number in d. lat. column against 96 in dist. column and the correction 94·5 s. will be found.

To find correction for decl. due to 9·6 h. from noon: 28·8′ is the change in 24 h. At 33° in the traverse-table we find 239·9 in d. lat. column against 286 in dist. column, and again 96·4 in d. lat. against 115 in dist. ∴ 11·5′ will be the correction (nearly).

NOTES ON MERCATOR AND MIDDLE-LATITUDE SAILINGS.

Mercator's sailing should be used generally when the course is between 1° and 70°, especially with long distances and in high latitudes. With a large course, and using either Raper or Norie, the distance may sometimes be considerably in error owing to the meridional parts not being given to decimals. The following examples will illustrate this:—

Find the true course and distance from lat. 5° 28′ N., long. 85° 30′ E., to lat. 5° 34′ N., long. 91° 0′ E.

By Mercator's Sailing (Raper's Tables).

Lat.	5° 28′ N	Mer. pts.	328′	Long.	85° 30′ E
Lat.	5 39 N	Mer. pts.	340	Long.	91 0 E
D. lat.	11 N	M. d. lat.	12		5 30 E
					60

D. long.	330′	Log	12·5185		
M. d. lat.	12′	Log	1·0792	D. lat. Log	1·0414
Course N. 87° 55′ E.		Tan	11·4393	Sec	1·4396
				Log	2·4810
				Distance	302·7 miles

By Inman's Tables.

5° 28′ N	Mer. pts.	328·50	D. long. 330′	Log	12·5185		
5 39 N	Mer. pts.	339·55	M. d. lat. 11·05′	Log	1·0434	D. lat. 11′	Log 1·0414
D. lat. 11 N	M. d. lat.	11·05	Course N. 88° 5′	Tan	11·4751	Sec of Co.	1·4753
				Distance	328·6 miles		Log 2·5167
				Raper	302·7		
				Difference	25·9 miles		

By Middle-latitude Sailing.

Lat.	5° 28′ N	D. long.	330′	Log	2·5185		
Lat.	5 39 N	Mid. lat.	5° 33½′	Cos	9·9980		
						Course 88° 5′	Sec 1·4753
Mid. L.	5 33½	Dep.	328·5	Log	12·5165	D. lat. 11′	Log 1·0414
		D. lat.	11′	Log	1·0414		
						Dist. 328·6 miles	Log 2·5167
		Course	88° 5′	Tan	11·4751		

To take out the distance accurately for a large course, as between 85° and 90°, the log. of secant should be taken out to seconds; this may be practically done by bearing in mind that the secant and tangent difference here are almost the same. Thus in the last example the difference between the sec. and tan. in the fourth figure is about 2; then add 2 to the log. tan. of course.

When the course is large the distance is very readily found from the traverse-table by a comparison of the dep. with the dist. column. For instance, with an 88° course, distance 329 is 0·2 greater than the departure; with an 87° course, distance 329 is 0·5 greater than the departure. In the same way, when the course is within 3° or 4° of the meridian, the distance will be nearly the same, but a trifle greater than the d. lat.

SIMPLE METHODS OF FINDING THE SHIP'S DISTANCE FROM A POINT BY TWO BEARINGS AND THE RUN IN INTERVAL BETWEEN THEM.

As so many strandings have occurred on the New Zealand coast owing to the neglect to take or make use of bearings, it has been thought advisable to give the following simple methods for *approximately* determining the ship's distance from a single point or light when cross-bearings are not obtainable. The methods here given have the advantage of being determined quickly, with a minimum of calculation, without leaving the deck or having to plot the bearings on a chart. Figure 3 and Table H were first published in the writer's first edition of "A and B Tables," &c., and their value has since been further impressed on navigators by the late Captain Lecky in the latest editions of his famous "Wrinkles." The writer has also been pleased to notice that some of the local steamers now have a brass plate on the bridge marked somewhat after the style of Figure 3.

PROBLEM 1.—*To find the Distance from a Point when the Angle on Bow is doubled.*

Whenever the angle between the course and object is doubled, the distance run in the interval is the distance off at second bearing. The well-known four-point bearing illustrates this, and, as the second bearing then gives the distance off abeam, it is most frequently used; but it is often very useful to be able to know the distance off at an earlier period, as illustrated by Fig. 1.

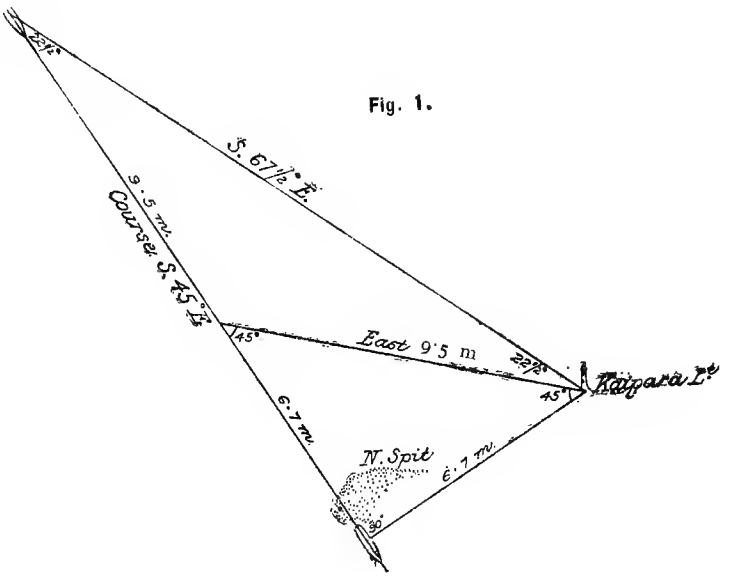


Fig. 1.

Example.—A ship making 10 miles an hour on a S.E. course by compass sighted Kaipara light, bearing E.S.E.; after continuing to make good the same course and speed for 57 m. the light bore E. Required the distance from the light when second bearing was taken.

First bearing E.S.E. 2 points on bow; second bearing E. 4 points on bow; angle doubled: the distance run in interval between bearings will be the distance off at last bearing. Interval 57 m. $= \frac{57}{60}$ or 0·95 of an hour × 10 gives run in interval, 9·5 m. the distance off.

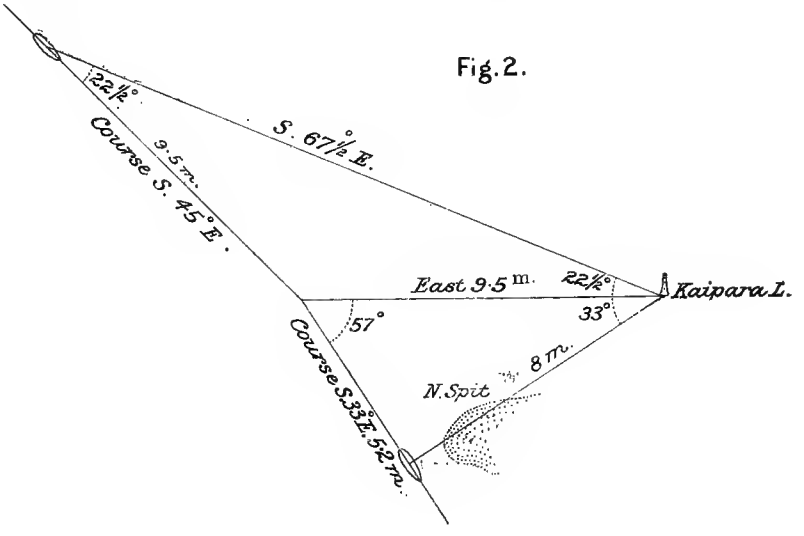
It is apparent from the figure that if this course is continued the ship will probably run foul of the North Spit. (See Fig. 1.)

Problem 2 will illustrate how by the aid of the traverse-table the course may quickly be set to pass a safe distance off.

PROBLEM 2.—*From a known Distance from Object, to set Course to pass any required Distance from it.*

Rule.—Enter the traverse-table with the distance required to pass off in the dep. column and the present distance off in dist. column. The course heading is will be the angle to bring the object on the bow.

Example as shown in Fig. 2.—Ship steering S. 45° E. by compass, Kaipara light bore E. distant 9·5 m. Set the course to pass 8 m. off the light. Enter the traverse-table with distance 9·5 in dist. column, and turn over until the nearest to 8·0 is found in dep. column. This is found at 57°. Bring the lighthouse 57° on bow, or course by compass S. 33° E. 9·5 in dist. column gives 7·97 in dep., and 5·17 in D. lat. column, the distance to run. Fig. 2 illustrates this

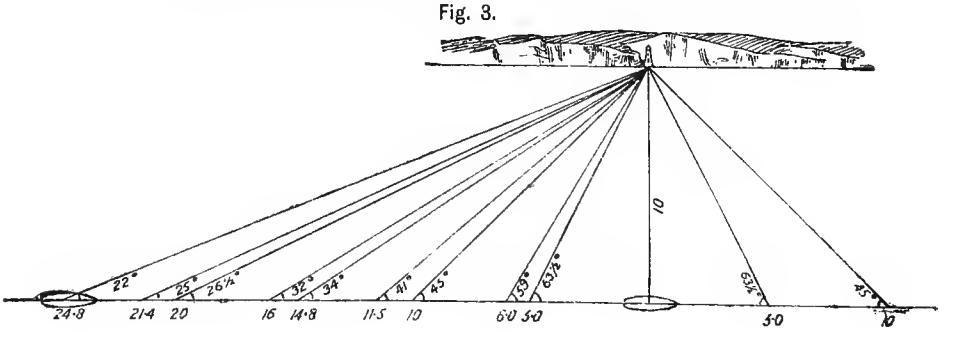


The advantage of knowing the distance that a ship will *pass off* a point on a given course, in good time before coming up to it, struck the writer many years ago when he was quite a junior officer, and he then made out the figure given below, which has often been used since.

The distance run in the interval between any two of the following bearings will give the distance that the ship will *pass off* the object if the same course is continued and *made good*.

PROBLEM 3.—*To find the Distance a Ship will pass off an Object when abeam by the Distance run in Interval between certain Bearings as given below.*

Fig. 3.



Between	22°	and 34°	The distance run will be the distance the ship will pass off
"	25°	" 41°	
"	26½°	" 45°	
"	32°	" 59°	
"	37°	" 72°	
"	45°	" 90°	
"	45°	" 63½°	the distance run will be half the distance the ship will pass off.

The numbers under base of figure represent the length of the base of the right-angled triangle proportionate to the perpendicular of 10. Thus, should the ship be passing 10 miles off an object, and the object be 22° on bow, ship will be 24·8 miles from the beam bearing.

The traverse-table gives the three sides of right-angled triangles for every degree of angle subtending the base or perpendicular. If, therefore, we know the angle on bow and the perpendicular—*i.e.*, the distance the ship will pass off the point when abeam—the other two sides of the triangle—viz., the distance off at the time, and the distance to run to beam bearing—are seen at a glance from the table.

Say angle on bow is 32°, and previous bearings give distance to pass off 10 m. Open traverse-table at 32° and against 10 in dep. column, we have 18·9 in dist. column as the distance off, and 16·0 in the D. lat. column as the distance to run to beam bearing.

Example.—A ship steering north observes a light bearing N. 32° E.; after running on same course for 6·0 miles the light bears N. 59° E. Required the distance the ship will pass *off* the light if she continues on the same course, and the distance *from* the light at time of second bearing.—*Answer:* Distance run in interval (6·0 miles) will be the distance the ship will pass off the light. Then, opening the traverse-table with 59° as course, and 6 in dep. column, we find 7 in dist. column as the distance the ship will be *from* object at that time.

As a ship changes the bearing of an object much more rapidly when nearing the beam bearing than at any other time, the distance that a ship passes off a point will be better determined by the run in interval between the two bearings of 63½° on bow and 63½° from stern—or, in other words, when it is 26½° from the beam bearing before and abaft—than at any other time.

It sometimes happens that a light or point is not sighted till after the ship has passed the four-point bearing. In such case Table H will be found useful, and might be copied out and put inside the wheel-house for ready reference.

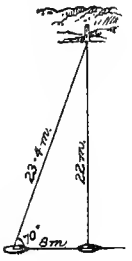
PROBLEM 4 (by Table H).—*To find the Distance from an Object when abeam by the Distance run between Beam Bearing and any other Bearing before or abaft the Beam.*

Table H.

°		°		°		°		°	
35	·70	45	1·00	55	1·43	65	2·14	75	3·73
36	·73	46	1·04	56	1·48	66	2·25	76	4·01
37	·75	47	1·07	57	1·54	67	2·36	77	4·33
38	·78	48	1·11	58	1·60	68	2·48	78	4·70
39	·81	49	1·15	59	1·66	69	2·61	79	5·14
40	·84	50	1·19	60	1·73	70	2·75	80	5·67
41	·87	51	1·23	61	1·80	71	2·90	81	6·31
42	·90	52	1·28	62	1·88	72	3·08	82	7·12
43	·93	53	1·33	63	1·96	73	3·27	83	8·14
44	·97	54	1·38	64	2·05	74	3·49	84	9·51

Rule.—Enter the table above with the number of degrees that the object is on the bow, and take out the factor given in the table abreast it. This factor multiplied by the run in the interval between the bearing on the bow and the bearing of the object when abeam will give the distance off when abeam.

Fig. 4.



Example.—A lighthouse is observed 70° on bow, ship's speed 10 m., and interval in time to beam bearing 48 min.

48 min. = 0·8 of an hour × 10 m. = 8 m. for the run in the interval.

Against 70° in the table is 2·75, which × 8 m. gives 22 m., the distance off when abeam; or by traverse-table, enter with 70°, and with distance run 8 m. in D. lat. column, gives distance off in dep. column = 22 m., and 23·4 m. the distance off when first bearing was taken.

Chart Methods.

Problem 1.—*To find the Distance from an Object by Two Bearings, and the Run in Interval between them.*

Rule.—Lay off the first bearing and the ship's course, then lay off the last bearing, and measure off the distance run on the course since the first one was taken; through this distance draw a line parallel to the first bearing: the point of intersection between this line and the second bearing should be the ship's position.

Example (see Fig. 5).—A ship steering from A towards B on a N. 20° E. course sights a point bearing N. 65° E.; after running on this course for 18·5 m. the point bears S. 70° E. Required the distance off at second bearing by plotting on the chart.

Lay off the course N. 20° E., also the bearing of P. N. 65° E.; then measure 18·5 m. on the line of course from this bearing, and make a mark; through this mark draw a line parallel to the bearing N. 65° E.; then the intersection of this line with the second bearing will be the ship's position, which gives 18·5 m. as the distance off.

Problem 2.—*To find the Distance from an Object by Two Bearings of Different Objects with Run in Interval between the Two Bearings.*

This problem is exactly the same in principle as the "Sumner" with two sun observations, and the writer when at sea often found it of great practical use, though he never found other navigators make use of the method (except after he had drawn their attention to it), nor is the method presented, so far as he is aware, in other nautical works. It is now given occasionally in New Zealand in the examination of masters and mates in the chart-examination problems.

Rule.—The rule for problem 2 will be exactly the same as for problem 1.

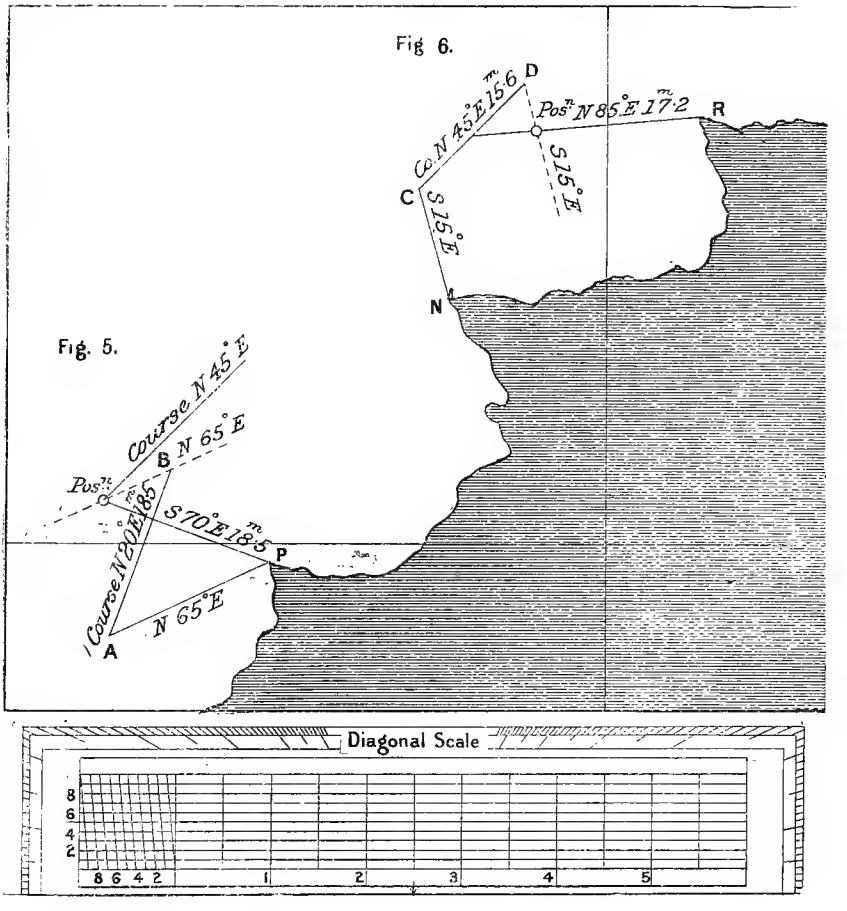
Example (see Fig. 6).—A ship steering from C towards D on a N. 45° E. course sights a point N. bearing S. 15° E.; after running on this course for 15·6 m. point R is sighted bearing N. 85° E. Required the distance from R at second bearing.

Lay off the course N. 45° E. from C to D, also the bearing of N. S. 15° E.; then measure 15·6 m. on the line of course from this bearing, and make a mark; through this mark draw a line parallel to the bearing S. 15° E.; then the intersection of this line with the second bearing will be the ship's position—viz., S. 85° W. 17·2 m. from point R.

This problem may often be used with advantage at night-time with two lights when one light is sighted shortly after the other one has been lost, or where the simultaneous bearing of two lights or two points makes too large an angle for a good fix. It will also be found useful in foggy weather in close navigation, where one near point after another may be just seen for a few minutes and then obscured

again. The bearing of these points in combination (the first bearing having been moved forward for the run in interval) will then generally give a good fix.

The distances in these plottings have been taken from the diagonal scale below the figures; the opportunity having been taken to draw attention to this handy useful scale, which any one can easily make for himself.



EXPLANATION OF THE DIAGONAL SCALE AND PROTRACTOR.

In the diagonal scale, the shorter lines dividing the length into equal portions (units) are crossed perpendicularly by 10 others extending the length of the scale. The end division, or unit, has its upper and lower edge subdivided into 10 equal parts, and diagonal lines are drawn from the beginning of one division to the end of the opposite one. This effects a further subdivision by 10, as an example will show. To take the No. 18·5 from this scale by the compasses: Set one foot at 1, and the other at the 8th line on the lower edge of the subdivided unit; this gives 18. Now follow up the diagonal line at the 8 to the 5th line of the long parallel lines, and fixing the point there, extend the other point to meet the line which rises at 1, crossing the breadth; and the number is taken.

The same process serves for tens and units as for units and tenths, and so on; thus the No. 1·85 or 185 is taken as above.

To lay off or measure an angle by the marked divisions. Place the middle point of the scale or ruler (which is strongly marked) on the meridian line, and, keeping it there, incline the ruler to the required angle, which is shown by the graduated scale of degrees coinciding with the upper part of the meridian line. Field's parallel ruler is marked in this way, and is very useful in laying off true bearings.

Caution.—The distance found by any of these methods from bearings with a run interval must only be considered as an *approximation*, as they depend on the course and distance run in interval having been made good. If, therefore, a current is known to exist, allowance must be made for it.

Cross-bearings of two (or, better still, three) prominent points will give a more certain position, provided the error of compass is known, and the angles are neither too large nor too small for a good "fix," and the points are accurately laid down on the chart; but every careful man will have at least two strings to his bow, and the position as found by run and interval will be a good check against possible errors. I think every one will admit their liability to such mistakes as reading off the wrong bearing, or applying the variation the wrong way, &c., and for this reason it is therefore always better to take *three* cross-bearings, when such are available.

Examples in the use of all these methods of finding the position of the ship by bearings, either with or without the chart, are given in the New Zealand examinations of either the home or foreign-going candidates for masters and mates.

The Compass and Pelorus.

Some owners do not seem to realize the value of having a proper compass, with a suitable position selected for it in the ship. Dozens of New Zealand ships would but for the Adjusters' reports be without any proper appliances for taking bearings, and many of the compasses are so closely surrounded by iron that no deviation card can be depended on. I would like here to point out the value in coastal navigation of having a Pelorus, which can be shifted to a stand made for it from one side of the bridge to the other, as is needed. The instrument is generally made of brass, being a *dumb* compass card *without needles*. It is a convenient plan to have the Pelorus set to the true geographical course, or else the magnetic course the ship is steering; then any bearings taken by it will be true, or magnetic, as the case may be, and free from the trouble of applying the error or variation of the compass. It may also be set to zero, N. or S., and the angle on the bow will then be readily read off for greater convenience in finding the distance off points, as in the problems which have been here mentioned.

Warning.—Do not use the Pelorus for long-distance bearings, such as Mount Egmont, 50 miles off.

SUPPLEMENTARY
EX-MERIDIAN TABLES.

EXPLANATION OF TABLES.

Ex-meridian Table No. 1.

The factor under the heading of Reduction abreast the A and B Correction is the reduction at 1 min. from the meridian to apply to an altitude to reduce it to the meridian altitude.

Instructions concerning the Use of Table and Rule for Application.

Multiply the factor corresponding to the A and B correction under the heading of Reduction by the number of minutes and decimals in the hour-angle from the meridian, which then gives the correction to apply to the observed altitude to reduce it to the meridian altitude. *Add* this correction to the observation taken near the upper meridian passage, and *subtract* the correction when observation is taken near the meridian below the Pole.

This reduction will not be more than $\frac{1}{2}'$ in error when the hour-angle is less than that shown in the accompanying table immediately following, which shows the limits within which it is safe to use the table without appreciable error.

Formula used in the calculation of the table:

$$\text{Reduction for 1 min.} = \frac{30' \, [A \pm B]}{1 + 2\,[A \pm B]^2}$$

(For example in use of the table, see page 152.)

Tables showing Limits of Reduction Tables No. 1 and No. 2.

These two tables show at a glance the hour-angles at which it is safe to use Reduction Tables No. 1 and No. 2, so that with the *correct time* the reduction will not be in error more than $\frac{1}{2}'$. It must, however, be borne in mind that the resulting latitude is the latitude corresponding to the meridian of longitude used in the deduction of the time. The A and B correction will readily show the line of position which must be laid down on the meridian of the D.R. longitude used in determining the time.

Ex-meridian Table No. 2.

The instructions and rules relating to this table are exactly the same as for Table No. 1.

Formula used in the calculation:

$$\text{Reduction for 1 min.} = \frac{15'}{2\,[A \pm B].}$$

Note.—This table is entirely independent of Table No. 1, which will generally give the best results and widest limit. Table No. 2 is given on account of the wide limits of reduction which it gives with high declinations and low latitudes; and

the same wide limits may be obtained when in high latitudes, and low declinations by transposing latitude for declination, and *vice versa*. A glance at the tables showing the limits of the two ex-meridian tables will at once show whether it is most advantageous to use No. 1 or No. 2 Ex-meridian Tables. (See example page 157.)

A truer formula than that used for either No. 1 or No. 2 Ex-meridian Tables would be

$$\text{Reduction} = \frac{30' \, [A \pm B]}{2 \, [A \pm B]^2 + \text{sec.}^2 \text{ lat.}}$$

After calculating and tabulating a portion of the table from this formula it was found that the gain in accuracy and extent of limit was so small that it did not seem to be worth the considerable additional space that would be needed for such a table. Moreover, the two tables now published give a wider range of limit than that of most other ex-meridian tables.

Table M.

SHOWING THE ERROR IN LATITUDE DUE TO AN ERROR OF 4 SECONDS IN TIME OR 1′ OF LONGITUDE.

This table (pages 150 and 151) shows at a glance the error which would result in the latitude from any single observation out of the meridian for every 4 sec. of error in the time.

When two observations are taken the factors given in this table facilitate the problem of finding the ship's position from two ex-meridian observations, or one chronometer observation, and an ex-meridian (see page 94).

Formula used in the calculation: Lat. error = Tan. azim. cos. lat.

Ex-meridian Table No. 1.

Showing the Reduction at 1 min. from the Meridian corresponding to the A and B Corrections given on Pages 12 to 37 of this Work.

A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.
′	′	′	′	′	′	′	′	′	′	′	′	′	′
2·00	3·529	2·70	2·686	3·40	2·159	4·10	1·802	4·80	1·546	5·50	1·352	6·20	1·202
2·01	3·514	2·71	2·676	3·41	2·153	4·11	1·798	4·81	1·542	5·51	1·350	6·21	1·200
2·02	3·498	2·72	2·667	3·42	2·147	4·12	1·794	4·82	1·539	5·52	1·348	6·22	1·198
2·03	3·483	2·73	2·658	3·43	2·141	4·13	1·790	4·83	1·536	5·53	1·345	6·23	1·196
2·04	3·468	2·74	2·649	3·44	2·135	4·14	1·786	4·84	1·533	5·54	1·343	6·24	1·194
2·05	3·453	2·75	2·640	3·45	2·129	4·15	1·781	4·85	1·530	5·55	1·340	6·25	1·192
2·06	3·438	2·76	2·631	3·46	2·123	4·16	1·777	4·86	1·527	5·56	1·338	6·26	1·191
2·07	3·423	2·77	2·622	3·47	2·117	4·17	1·773	4·87	1·524	5·57	1·336	6·27	1·189
2·08	3·409	2·78	2·613	3·48	2·112	4·18	1·769	4·88	1·521	5·58	1·333	6·28	1·187
2·09	3·394	2·79	2·604	3·49	2·106	4·19	1·765	4·89	1·518	5·59	1·331	6·29	1·185
2·10	3·380	2·80	2·596	3·50	2·100	4·20	1·761	4·90	1·515	5·60	1·329	6·30	1·183
2·11	3·366	2·81	2·587	3·51	2·094	4·21	1·757	4·91	1·512	5·61	1·326	6·31	1·181
2·12	3·351	2·82	2·578	3·52	2·089	4·22	1·753	4·92	1·509	5·62	1·324	6·32	1·179
2·13	3·337	2·83	2·570	3·53	2·083	4·23	1·749	4·93	1·506	5·63	1·322	6·33	1·177
2·14	3·323	2·84	2·561	3·54	2·077	4·24	1·745	4·94	1·503	5·64	1·320	6·34	1·176
2·15	3·309	2·85	2·553	3·55	2·072	4·25	1·741	4·95	1·500	5·65	1·317	6·35	1·174
2·16	3·296	2·86	2·545	3·56	2·066	4·26	1·737	4·96	1·497	5·66	1·315	6·36	1·172
2·17	3·282	2·87	2·536	3·57	2·060	4·27	1·733	4·97	1·494	5·67	1·313	6·37	1·170
2·18	3·268	2·88	2·528	3·58	2·055	4·28	1·729	4·98	1·491	5·68	1·310	6·38	1·168
2·19	3·255	2·89	2·520	3·59	2·049	4·29	1·725	4·99	1·488	5·69	1·308	6·39	1·167
2·20	3·242	2·90	2·512	3·60	2·044	4·30	1·721	5·00	1·485	5·70	1·306	6·40	1·165
2·21	3·228	2·91	2·503	3·61	2·038	4·31	1·717	5·01	1·482	5·71	1·303	6·41	1·163
2·22	3·215	2·92	2·495	3·62	2·033	4·32	1·713	5·02	1·479	5·72	1·301	6·42	1·161
2·23	3·202	2·93	2·487	3·63	2·028	4·33	1·709	5·03	1·476	5·73	1·299	6·43	1·159
2·24	3·189	2·94	2·479	3·64	2·023	4·34	1·705	5·04	1·474	5·74	1·297	6·44	1·158
2·25	3·176	2·95	2·471	3·65	2·017	4·35	1·702	5·05	1·471	5·75	1·294	6·45	1·156
2·26	3·164	2·96	2·463	3·66	2·012	4·36	1·698	5·06	1·468	5·76	1·292	6·46	1·154
2·27	3·151	2·97	2·456	3·67	2·006	4·37	1·694	5·07	1·465	5·77	1·290	6·47	1·152
2·28	3·139	2·98	2·448	3·68	2·001	4·38	1·690	5·08	1·462	5·78	1·288	6·48	1·150
2·29	3·126	2·99	2·440	3·69	1·996	4·39	1·687	5·09	1·459	5·79	1·286	6·49	1·149
2·30	3·114	3·00	2·432	3·70	1·991	4·40	1·683	5·10	1·457	5·80	1·284	6·50	1·147
2·31	3·101	3·01	2·425	3·71	1·986	4·41	1·679	5·11	1·454	5·81	1·281	6·51	1·145
2·32	3·089	3·02	2·417	3·72	1·980	4·42	1·675	5·12	1·451	5·82	1·279	6·52	1·144
2·33	3·077	3·03	2·410	3·73	1·975	4·43	1·672	5·13	1·448	5·83	1·277	6·53	1·142
2·34	3·065	3·04	2·402	3·74	1·970	4·44	1·668	5·14	1·445	5·84	1·275	6·54	1·140
2·35	3·053	3·05	2·395	3·75	1·965	4·45	1·664	5·15	1·443	5·85	1·273	6·55	1·138
2·36	3·041	3·06	2·387	3·76	1·960	4·46	1·661	5·16	1·440	5·86	1·270	6·56	1·137
2·37	3·030	3·07	2·380	3·77	1·955	4·47	1·657	5·17	1·437	5·87	1·268	6·57	1·135
2·38	3·018	3·08	2·373	3·78	1·950	4·48	1·654	5·18	1·435	5·88	1·266	6·58	1·133
2·39	3·006	3·09	2·365	3·79	1·945	4·49	1·650	5·19	1·432	5·89	1·264	6·59	1·131
2·40	2·995	3·10	2·358	3·80	1·940	4·50	1·646	5·20	1·429	5·90	1·262	6·60	1·130
2·41	2·984	3·11	2·351	3·81	1·935	4·51	1·643	5·21	1·426	5·91	1·260	6·61	1·128
2·42	2·972	3·12	2·344	3·82	1·930	4·52	1·639	5·22	1·424	5·92	1·258	6·62	1·127
2·43	2·961	3·13	2·337	3·83	1·925	4·53	1·636	5·23	1·421	5·93	1·256	6·63	1·125
2·44	2·950	3·14	2·329	3·84	1·921	4·54	1·632	5·24	1·418	5·94	1·254	6·64	1·123
2·45	2·939	3·15	2·322	3·85	1·916	4·55	1·629	5·25	1·416	5·95	1·252	6·65	1·122
2·46	2·928	3·16	2·315	3·86	1·911	4·56	1·625	5·26	1·413	5·96	1·250	6·66	1·120
2·47	2·917	3·17	2·308	3·87	1·906	4·57	1·622	5·27	1·410	5·97	1·247	6·67	1·118
2·48	2·906	3·18	2·302	3·88	1·901	4·58	1·618	5·28	1·408	5·98	1·245	6·68	1·117
2·49	2·895	3·19	2·295	3·89	1·897	4·59	1·615	5·29	1·405	5·99	1·243	6·69	1·115
2·50	2·885	3·20	2·288	3·90	1·892	4·60	1·611	5·30	1·403	6·00	1·241	6·70	1·113
2·51	2·874	3·21	2·281	3·91	1·887	4·61	1·608	5·31	1·400	6·01	1·239	6·71	1·112
2·52	2·863	3·22	2·274	3·92	1·883	4·62	1·605	5·32	1·397	6·02	1·237	6·72	1·110
2·53	2·853	3·23	2·268	3·93	1·878	4·63	1·601	5·33	1·395	6·03	1·235	6·73	1·108
2·54	2·843	3·24	2·261	3·94	1·873	4·64	1·598	5·34	1·392	6·04	1·233	6·74	1·107
2·55	2·832	3·25	2·254	3·95	1·869	4·65	1·594	5·35	1·390	6·05	1·231	6·75	1·105
2·56	2·822	3·26	2·248	3·96	1·864	4·66	1·591	5·36	1·387	6·06	1·229	6·76	1·103
2·57	2·812	3·27	2·241	3·97	1·860	4·67	1·588	5·37	1·385	6·07	1·227	6·77	1·102
2·58	2·802	3·28	2·235	3·98	1·855	4·68	1·584	5·38	1·382	6·08	1·225	6·78	1·100
2·59	2·792	3·29	2·228	3·99	1·851	4·69	1·581	5·39	1·380	6·09	1·223	6·79	1·099
2·60	2·782	3·30	2·222	4·00	1·846	4·70	1·578	5·40	1·377	6·10	1·221	6·80	1·097
2·61	2·772	3·31	2·215	4·01	1·842	4·71	1·575	5·41	1·375	6·11	1·219	6·81	1·095
2·62	2·762	3·32	2·209	4·02	1·837	4·72	1·571	5·42	1·372	6·12	1·217	6·82	1·094
2·63	2·752	3·33	2·203	4·03	1·833	4·73	1·568	5·43	1·370	6·13	1·215	6·83	1·092
2·64	2·742	3·34	2·196	4·04	1·828	4·74	1·565	5·44	1·367	6·14	1·213	6·84	1·091
2·65	2·733	3·35	2·190	4·05	1·824	4·75	1·562	5·45	1·365	6·15	1·211	6·85	1·089
2·66	2·723	3·36	2·184	4·06	1·820	4·76	1·558	5·46	1·362	6·16	1·210	6·86	1·088
2·67	2·714	3·37	2·178	4·07	1·815	4·77	1·555	5·47	1·360	6·17	1·208	6·87	1·086
2·68	2·704	3·38	2·171	4·08	1·811	4·78	1·552	5·48	1·357	6·18	1·206	6·88	1·084
2·69	2·695	3·39	2·165	4·09	1·807	4·79	1·549	5·49	1·355	6·19	1·204	6·89	1·083

Ex-meridian Table No. 1.

Showing the Reduction at 1 min. from the Meridian corresponding to the A and B Corrections given on Pages 12 to 37 of this Work.

A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.
′	′	′	′	′	′	′	′	′	′	′	′	′	′
6·90	1·081	7·60	·983	8·60	·869	10·00	·748	11·40	·657	12·80	·585	14·20	·527
6·91	1·080	7·61	·981	8·62	·867	10·02	·747	11·42	·655	12·82	·584	14·22	·527
6·92	1·078	7·62	·980	8·64	·865	10·04	·745	11·44	·654	12·84	·583	14·24	·526
6·93	1·077	7·63	·979	8·66	·863	10·06	·744	11·46	·653	12·86	·582	14·26	·525
6·94	1·075	7·64	·977	8·68	·861	10·08	·742	11·48	·652	12·88	·581	14·28	·525
6·95	1·074	7·65	·976	8·70	·859	10·10	·741	11·50	·651	12·90	·581	14·30	·524
6·96	1·072	7·66	·975	8·72	·857	10·12	·739	11·52	·650	12·92	·580	14·32	·523
6·97	1·071	7·67	·974	8·74	·855	10·14	·738	11·54	·649	12·94	·579	14·34	·522
6·98	1·069	7·68	·972	8·76	·853	10·16	·736	11·56	·648	12·96	·578	14·36	·522
6·99	1·068	7·69	·971	8·78	·852	10·18	·735	11·58	·646	12·98	·577	14·38	·521
7·00	1·066	7·70	·970	8·80	·850	10·20	·734	11·60	·645	13·00	·576	14·40	·520
7·01	1·065	7·71	·969	8·82	·848	10·22	·732	11·62	·644	13·02	·575	14·42	·519
7·02	1·063	7·72	·967	8·84	·846	10·24	·731	11·64	·643	13·04	·574	14·44	·519
7·03	1·062	7·73	·966	8·86	·844	10·26	·729	11·66	·642	13·06	·573	14·46	·518
7·04	1·060	7·74	·965	8·88	·842	10·28	·728	11·68	·641	13·08	·573	14·48	·517
7·05	1·059	7·75	·964	8·90	·840	10·30	·726	11·70	·640	13·10	·572	14·50	·517
7·06	1·057	7·76	·962	8·92	·838	10·32	·725	11·72	·639	13·12	·571	14·60	·513
7·07	1·056	7·77	·961	8·94	·836	10·34	·724	11·74	·638	13·14	·570	14·70	·510
7·08	1·054	7·78	·960	8·96	·835	10·36	·722	11·76	·637	13·16	·569	14·80	·506
7·09	1·053	7·79	·959	8·98	·833	10·38	·721	11·78	·636	13·18	·568	14·90	·503
7·10	1·051	7·80	·958	9·00	·831	10·40	·720	11·80	·634	13·20	·567	15·00	·499
7·11	1·050	7·81	·956	9·02	·829	10·42	718	11·82	·633	13·22	·566	15·10	·496
7·12	1·048	7·82	·955	9·04	·827	10·44	·717	11·84	·632	13·24	·566	15·20	·493
7·13	1·047	7·83	·954	9·06	·825	10·46	·715	11·86	·631	13·26	·565	15·30	·490
7·14	1·045	7·84	·953	9·08	·824	10·48	·714	11·88	·630	13·28	·564	15·40	·487
7·15	1·044	7·85	·952	9·10	·822	10·50	·713	11·90	·629	13·30	·563	15·50	·483
7·16	1·042	7·86	·950	9·12	·820	10·52	·711	11·92	·628	13·32	·562	15·60	·480
7·17	1·041	7·87	·949	9·14	·818	10·54	·710	11·94	·627	13·34	·561	15·70	·477
7·18	1·040	7·88	·948	9·16	·816	10·56	·709	11·96	·626	13·36	·561	15·80	·474
7·19	1·038	7·89	·947	9·18	·815	10·58	·707	11·98	·625	13·38	·560	15·90	·471
7·20	1·037	7·90	·946	9·20	·813	10·60	·706	12·00	·624	13·40	·559	16·00	·468
7·21	1·035	7·91	·944	9·22	·811	10·62	·705	12·02	·623	13·42	·558	16·10	·465
7·22	1·034	7·92	·943	9·24	·809	10·64	·703	12·04	622	13·44	·557	16·20	·463
7·23	1·032	7·93	·942	9·26	·808	10·66	·702	12·06	·621	13·46	·556	16·30	·460
7·24	1·031	7·94	·941	9·28	·806	10·68	·701	12·08	·620	13·48	·556	16·40	·457
7·25	1·030	7·95	·940	9·30	·804	10·70	·699	12·10	·619	13·50	·555	16·50	·454
7·26	1·028	7·96	·939	9·32	·802	10·72	·698	12·12	·618	13·52	·554	16·60	·451
7·27	1·027	7·97	·937	9·34	·801	10·74	·697	12·14	·617	13·54	·553	16·70	·449
7·28	1·025	7·98	·936	9·36	·799	10·76	·696	12·16	·616	13·56	·552	16·80	·446
7·29	1·024	7·99	·935	9·38	·797	10·78	·694	12·18	·615	13·58	·551	16·90	·443
7·30	1·023	8·00	·934	9·40	796	10·80	·693	12·20	·614	13·60	·551	17·00	·441
7·31	1·021	8·02	·932	9·42	·794	10·82	·692	12·22	·613	13·62	·550	17·10	·438
7·32	1·020	8·04	·929	9·44	·792	10·84	·690	12·24	·612	13·64	·549	17·20	·436
7·33	1·018	8·06	·927	9·46	·791	10·86	·689	12·26	·611	13·66	·548	17·30	·433
7·34	1·017	8·08	·925	9·48	·789	10·88	·688	12·28	·610	13·68	·548	17·40	·431
7·35	1·016	8·10	·922	9·50	·787	10·90	·687	12·30	·609	13·70	·547	17·50	·428
7·36	1·014	8·12	·920	9·52	·786	10·92	·685	12·32	·608	13·72	·546	17·60	·426
7·37	1·013	8·14	·918	9·54	·784	10·94	·684	12·34	·607	13·74	·545	17·70	·423
7·38	1·012	8·16	·916	9·56	·782	10·96	·683	12·36	606	13·76	·544	17·80	·421
7·39	1·010	8·18	·913	9·58	·781	10·98	·682	12·38	·605	13·78	·543	17·90	·419
7·40	1·009	8·20	·911	9·60	·779	11·00	·680	12·40	·604	13·80	·543	18·00	·416
7·41	1·008	8·22	·909	9·62	·778	11·02	·679	12·42	·603	13·82	·542	18·10	·414
7·42	1·006	8·24	·907	9·64	·776	11·04	·678	12·44	·602	13·84	·541	18·20	·412
7·43	1·005	8·26	·905	9·66	·774	11·06	·677	12·46	·601	13·86	·540	18·30	·410
7·44	1·004	8·28	·902	9·68	·773	11·08	·676	12·48	·600	13·88	·540	18·40	·407
7·45	1·002	8·30	·900	9·70	·771	11·10	·674	12·50	·599	13·90	·539	18·50	·405
7·46	1·001	8·32	·898	9·72	·770	11·12	·673	12·52	·598	13·92	·538	18·60	·403
7·47	·999	8·34	·896	9·74	·768	11·14	·672	12·54	·597	13·94	·537	18·70	·401
7·48	·998	8·36	·894	9·76	·766	11·16	·671	12·56	·596	13·96	·536	18·80	·399
7·49	·997	8·38	·892	9·78	·765	11·18	·670	12·58	·595	13·98	·536	18·90	·397
7·50	·996	8·40	·890	9·80	·763	11·20	·668	12·60	·594	14·00	·535	19·00	·394
7·51	·994	8·42	·888	9·82	·762	11·22	·667	12·62	·593	14·02	·534	19·10	·392
7·52	·993	8·44	·885	9·84	·760	11·24	·666	12·64	·592	14·04	·533	19·20	·390
7·53	·992	8·46	·883	9·86	·759	11·26	·665	12·66	·591	14·06	·533	19·30	·388
7·54	·990	8·48	·881	9·88	·757	11·28	·664	12·68	·591	14·08	·532	19·40	·386
7·55	·989	8·50	·879	9·90	·756	11·30	·662	12·70	·590	14·10	·531	19·50	·384
7·56	·988	8·52	·877	9·92	·754	11·32	·661	12·72	·589	14·12	·530	19·60	·382
7·57	·986	8·54	·875	9·94	·753	11·34	·660	12·74	·588	14·14	·530	19·70	·380
7·58	·985	8·56	·873	9·96	·751	11·36	·659	12·76	·587	14·16	·529	19·80	·379
7·59	·984	8·58	·871	9·98	·750	11·38	·658	12·78	·586	14·18	·528	20·00	·375

Table showing the Hour-angle Limits within which the Error of the Reduction calculated by Ex-meridian Table No. 1 will not exceed 0'·5.

LATITUDE AND DECLINATION OF *SAME* NAME.

Latitude.	Declination.					Vega.	Capella.	α Persei.	Canopus.	ε Ursæ Majoris.	Achernar.	α Centauri.	Dubhe.	α Crucis.	α Trianguli Australis.	β Argûs.
	0°	5°	10°	20°	30°											
°	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
0	..	10*n*	20*n*	36*g*	47*g*	52*g*	57*g*	59*g*	60*g*	62*g*	63*g*	64*g*	66*g*	66*g*	70*g*	70*g*
5	10*n*	..	10*n*	31*g*	41*g*	49*g*	52*g*	54*g*	57*g*	58*g*	60*g*	61*g*	64*g*	64*g*	68*g*	68*g*
10	20*n*	10*n*	..	21*g*	38*g*	43*g*	49*g*	51*g*	54*g*	56*g*	57*g*	58*g*	60*g*	60*g*	66*g*	66*g*
15	29*l*	20*n*	10*n*	11*n*	32*g*	42*g*	44*g*	48*g*	52*g*	54*g*	54*g*	56*g*	57*g*	58*g*	64*g*	64*g*
20	30*l*	24*l*	20*l*	..	24*n*	41*g*	44*g*	46*g*	47*g*	52*g*	52*g*	52*g*	57*g*	57*g*	62*g*	63*g*
25	30*l*	26*l*	22*l*	10*l*	12*n*	39*n*	43*g*	44*g*	47*g*	48*g*	49*g*	52*g*	54*g*	56*g*	60*g*	61*g*
30	32*l*	29*l*	25*l*	17*l*	..	25*l*	43*l*	44*g*	46*g*	47*g*	48*g*	52*g*	52*g*	52*g*	58*g*	59*g*
35	36*l*	30*l*	28*l*	21*l*	10*n*	..	31*l*	54*g*	47*g*	47*g*	48*g*	52*g*	52*g*	52*g*	56*g*	57*g*
40	38*l*	32*l*	30*l*	24*l*	16*l*	..	11*n*	26*l*	42*l*	52*g*	52*g*	50*g*	53*g*	51*g*	56*g*	57*g*
45	39*l*	35*l*	32*l*	27*l*	21*l*	12*l*	..	..	21*l*	35*l*	44*l*	60*g*	55*g*	52*g*	55*g*	54*g*
50	40*l*	37*l*	35*l*	32*l*	25*l*	18*l*	10*l*	..	14*l*	18*l*	22*l*	34*l*	52*l*	53*l*	55*g*	54*g*
55	40*l*	39*l*	37*l*	34*l*	29*l*	24*l*	17*l*	12*l*	..	..	..	17*l*	23*l*	24*l*	64*g*	64*g*
60	43*l*	40*l*	40*l*	39*l*	32*l*	28*l*	23*l*	20*l*	16*l*	9*l*	..	..	..	..	39*l*	43*l*
65	45*l*	42*l*	42*l*	40*l*	37*l*	32*l*	29*l*	26*l*	23*l*	19*l*	17*l*	14*l*	..	..	..	..
70	48*l*	47*l*	46*l*	43*l*	40*l*	38*l*	34*l*	32*l*	30*l*	28*l*	27*l*	23*l*	22*l*	21*l*	..	..
75	52*l*	51*l*	50*l*	48*l*	46*l*	44*l*	42*l*	40*l*	38*l*	36*l*	34*l*	32*l*	30*l*	30*l*	23*l*	21*l*
80	57*l*	56*l*	55*l*	54*l*	52*l*	51*l*	50*l*	49*l*	48*l*	47*l*	46*l*	44*l*	43*l*	43*l*	39*l*	37*l*
85	66*l*	66*l*	66*l*	66*l*	64*l*	64*l*	63*l*	62*l*	62*l*	61*l*	61*l*	60*l*	59*l*	59*l*	57*l*	56*l*

INFERIOR TRANSIT.

NOTE.

g signifies true reduction is *greater* than tabular reduction.

l signifies that true reduction is *less* than tabular reduction.

n signifies that there is no error as great as 0'·5 within limits of hour-angle which give A ± B greater than 2'·000.

Lat.												
°												
25	..	..	..	..	..	..	..	..	..	89*g*	88*g*	
30	..	..	..	..	..	..	..	114*g*	114*g*	98*g*	98*g*	
35	..	..	..	..	100*l*	100*l*	118*l*	172*g*	164*g*	107*g*	107*g*	
40	..	..	..	76*l*	84*l*	88*l*	104*l*	110*l*	112*l*	132*g*	128*g*	
45	..	..	68*l*	71*l*	80*l*	80*l*	86*l*	92*l*	92*l*	160*l*	196*g*	
50	..	61*l*	64*l*	68*l*	72*l*	76*l*	80*l*	86*l*	87*l*	110*l*	112*l*	
55	56*l*	60*l*	63*l*	65*l*	69*l*	70*l*	74*l*	78*l*	78*l*	96*l*	98*l*	
60	56*l*	59*l*	61*l*	65*l*	69*l*	68*l*	70*l*	74*l*	76*l*	90*l*	92*l*	
65	56*l*	58*l*	61*l*	64*l*	66*l*	66*l*	70*l*	73*l*	74*l*	82*l*	84*l*	
70	56*l*	60*l*	62*l*	62*l*	66*l*	64*l*	68*l*	70*l*	70*l*	78*l*	78*l*	
75	58*l*	62*l*	62*l*	64*l*	66*l*	64*l*	66*l*	66*l*	66*l*	77*l*	77*l*	
80	60*l*	64*l*	64*l*	67*l*	67*l*	67*l*	69*l*	70*l*	70*l*	74*l*	74*l*	
85	72*l*	72*l*	74*l*	75*l*	75*l*	76*l*	78*l*	78*l*	78*l*	81*l*	81*l*	

LATITUDE AND DECLINATION OF *CONTRARY* NAME.

Latitude.	Declination.					Vega.	Capella.	α Persei.	Canopus.	ε Ursæ Majoris.	Achernar.	α Centauri.	Dubhe.	α Crucis.	α Trianguli Australis.	β Argûs.
	0°	5°	10°	20°	30°											
°	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
5	10*n*	20*n*	29*n*	46*g*	52*g*	60*g*	62*g*	62*g*	64*g*	66*g*	68*g*	67*g*	68*g*	68*g*	72*g*	72*g*
10	20*n*	30*n*	40*n*	61*n*	70*g*	72*g*	68*g*	68*g*	71*g*	70*g*	70*g*	70*g*	72*g*	74*g*	75*g*	76*g*
15	29*l*	40*l*	40*l*	54*l*	97*n*	94*g*	82*g*	78*g*	79*g*	80*g*	77*g*	76*g*	77*g*	78*g*	79*g*	80*g*
20	30*l*	40*l*	40*l*	50*l*	65*l*	94*l*	120*g*	100*g*	94*g*	88*g*	89*g*	80*g*	83*g*	84*g*	..	..
25	30*l*	36*l*	40*l*	48*l*	56*l*	72*l*	96*l*	120*l*	133*g*	104*g*	100*g*	96*g*	..	..	..	..
30	32*l*	36*l*	40*l*	46*l*	53*l*	65*l*	78*l*	84*l*	102*l*	..	..	..	..	..	..	..
35	36*l*	37*l*	40*l*	45*l*	52*l*	65*l*	72*l*	76*l*	..	..	..	..	..	..	..	..
40	38*l*	38*l*	40*l*	45*l*	52*l*	60*l*	..	..	..	..	..	..	..	..	..	..
45	39*l*	39*l*	42*l*	46*l*	52*l*	55*l*	..	..	..	..	..	..	..	..	..	..
50	40*l*	40*l*	43*l*	47*l*	52*l*	..	..	..	..	..	..	..	..	..	..	..
55	40*l*	42*l*	44*l*	48*l*	52*l*	..	..	..	..	..	..	..	..	..	..	..
60	43*l*	44*l*	45*l*	48*l*	..	..	..	..	..	..	..	..	..	..	..	..
65	45*l*	46*l*	46*l*	49*l*	..	..	..	..	..	..	..	..	..	..	..	..
70	48*l*	49*l*	51*l*	..	..	..	..	..	..	..	..	..	..	..	..	..
75	52*l*	53*l*	54*l*	..	..	..	..	..	..	..	..	..	..	..	..	..
80	57*l*	57*l*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
85	66*l*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Table showing the Hour-angle Limits within which the Error of the Reduction calculated by Ex-meridian Table No. 2 will not exceed 0'·5.

LATITUDE AND DECLINATION OF *SAME* NAME.

Latitude.	Declination. 0°	5°	10°	20°	30°	Vega.	Capella.	α Persei.	Canopus.	ε Ursæ Majoris.	Achernar.	α Centauri.	Dubhe.	α Crucis.	α Trianguli Australis.	β Argûs.
°	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
0	..	6*n*	11*l*	19*l*	28*l*	38*l*	49*l*	55*l*	65*l*	91*l*	126*l*	107*g*	96*g*	95*g*	82*g*	82*g*
5	6*n*	..	6*n*	16*l*	24*l*	36*l*	45*l*	52*l*	56*l*	90*l*	120*n*	100*g*	84*g*	82*g*	80*g*	80*g*
10	10*l*	6*n*	..	10*l*	20*l*	32*l*	40*l*	50*l*	54*l*	85*l*	113*n*	94*g*	82*g*	80*g*	76*g*	76*g*
15	15*l*	10*l*	6*n*	7*l*	16*l*	26*l*	38*l*	47*l*	52*l*	80*l*	106*n*	90*g*	82*g*	82*g*	74*g*	72*g*
20	18*l*	15*l*	12*l*	..	12*l*	20*l*	35*l*	44*l*	48*l*	72*l*	98*n*	90*g*	79*g*	78*g*	72*g*	72*g*
25	22*l*	19*l*	16*l*	7*l*	7*l*	14*l*	30*l*	38*l*	44*l*	58*l*	65*l*	94*g*	81*g*	81*g*	70*g*	68*g*
30	25*l*	22*l*	19*l*	11*l*	..	13*l*	24*l*	30*l*	37*l*	50*l*	56*l*	96*n*	83*g*	83*g*	68*g*	68*g*
35	27*l*	24*l*	22*l*	16*l*	7*l*	..	16*l*	25*l*	30*l*	42*l*	44*l*	74*l*	98*g*	99*g*	66*g*	66*g*
40	30*l*	27*l*	25*l*	19*l*	12*l*	..	10*l*	17*l*	24*l*	32*l*	36*l*	50*l*	62*l*	64*l*	66*g*	66*g*
45	32*l*	30*l*	28*l*	22*l*	16*l*	10*l*	..	..	15*l*	25*l*	27*l*	36*l*	42*l*	42*l*	68*g*	67*g*
50	34*l*	33*l*	30*l*	25*l*	20*l*	16*l*	9*l*	..	..	15*l*	18*l*	22*l*	31*l*	31*l*	84*g*	78*g*
55	36*l*	36*l*	33*l*	28*l*	24*l*	22*l*	15*l*	10*l*	..	..	..	15*l*	20*l*	21*l*	54*l*	60*l*
60	39*l*	38*l*	36*l*	34*l*	28*l*	26*l*	22*l*	18*l*	14*l*	9*l*	..	..	..	..	33*l*	35*l*
65	43*l*	42*l*	41*l*	38*l*	35*l*	32*l*	28*l*	25*l*	23*l*	19*l*	17*l*	13*l*	..	..	..	..
70	47*l*	46*l*	45*l*	42*l*	40*l*	37*l*	34*l*	32*l*	30*l*	27*l*	25*l*	23*l*	21*l*	21*l*	..	..
75	51*l*	50*l*	50*l*	47*l*	46*l*	43*l*	41*l*	39*l*	37*l*	36*l*	34*l*	32*l*	30*l*	30*l*	20*l*	20*l*
80	57*l*	56*l*	55*l*	54*l*	52*l*	51*l*	50*l*	49*l*	48*l*	47*l*	46*l*	44*l*	43*l*	43*l*	39*l*	37*l*
85	66*l*	66*l*	66*l*	66*l*	64*l*	64*l*	63*l*	62*l*	62*l*	61*l*	61*l*	60*l*	59*l*	59*l*	57*l*	56*l*

INFERIOR TRANSIT.

NOTE.

g signifies true reduction is *greater* than tabular reduction.

l signifies that true reduction is *less* than tabular reduction.

n signifies that there is no error as great as 0'·5 within limits of hour-angle which give A ± B greater than 3'·000.

Lat. °												
25	..	..	..	..	..	..	..	..	..	105*g*	100*g*
30	..	..	..	..	..	..	..	90*l*	92*l*	140*g*	115*g*
35	..	..	..	..	72*l*	74*l*	80*l*	84*l*	85*l*	170*l*	160*g*
40	..	..	58*l*	62*l*	68*l*	71*l*	77*l*	80*l*	80*l*	120*l*	140*l*
45	..	56*l*	58*l*	62*l*	68*l*	70*l*	74*l*	76*l*	78*l*	100*l*	110*l*
50	..	56*l*	60*l*	61*l*	67*l*	69*l*	71*l*	75*l*	76*l*	92*l*	96*l*
55	53*l*	57*l*	60*l*	62*l*	66*l*	67*l*	69*l*	73*l*	73*l*	82*l*	86*l*
60	52*l*	57*l*	59*l*	62*l*	64*l*	66*l*	68*l*	71*l*	71*l*	80*l*	84*l*
65	54*l*	58*l*	59*l*	62*l*	64*l*	66*l*	68*l*	70*l*	69*l*	78*l*	82*l*
70	56*l*	60*l*	62*l*	62*l*	64*l*	64*l*	66*l*	68*l*	68*l*	74*l*	78*l*
75	58*l*	62*l*	62*l*	64*l*	64*l*	64*l*	66*l*	66*l*	66*l*	77*l*	77*l*
80	60*l*	64*l*	64*l*	67*l*	67*l*	67*l*	69*l*	70*l*	70*l*	74*l*	74*l*
85	72*l*	72*l*	74*l*	75*l*	75*l*	76*l*	78*l*	78*l*	78*l*	81*l*	81*l*

LATITUDE AND DECLINATION OF *CONTRARY* NAME.

Latitude.	Declination. 0°	5°	10°	20°	30°	Vega.	Capella.	α Persei.	Canopus.	ε Ursæ Majoris.	Achernar.	α Centauri.	Dubhe.	α Crucis.	α Trianguli Australis.	β Argûs.
°	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
5	6*n*	10*l*	16*l*	23*l*	28*l*	40*l*	50*l*	60*l*	62*l*	84*l*	106*l*	120*g*	100*g*	106*g*	84*g*	84*g*
10	10*l*	15*l*	19*l*	26*l*	32*l*	44*l*	56*l*	60*l*	62*l*	80*l*	92*l*	154*g*	120*g*	120*g*	90*g*	80*g*
15	15*l*	19*l*	22*l*	29*l*	36*l*	45*l*	56*l*	60*l*	63*l*	77*l*	84*l*	114*l*	152*g*	146*g*	100*g*	96*g*
20	18*l*	23*l*	25*l*	32*l*	38*l*	46*l*	56*l*	60*l*	64*l*	75*l*	74*l*	96*l*	136*l*	128*l*	..	..
25	22*l*	26*l*	28*l*	34*l*	40*l*	47*l*	56*l*	60*l*	64*l*	72*l*	84*l*	88*l*	..	..	..	..
30	25*l*	28*l*	32*l*	36*l*	42*l*	48*l*	56*l*	60*l*	64*l*	70*l*	..	..	..	..	..	..
35	27*l*	30*l*	34*l*	38*l*	44*l*	48*l*	56*l*	60*l*	..	..	..	..	..	..	..	..
40	30*l*	32*l*	35*l*	39*l*	46*l*	50*l*	..	..	..	..	..	..	..	..	..	..
45	32*l*	33*l*	36*l*	40*l*	48*l*	52*l*	..	..	..	..	..	..	..	..	..	..
50	34*l*	34*l*	38*l*	42*l*	50*l*	..	..	..	..	..	..	..	..	..	..	..
55	36*l*	36*l*	40*l*	44*l*	52*l*	..	..	..	..	..	..	..	..	..	..	..
60	39*l*	39*l*	44*l*	46*l*	..	..	..	..	..	..	..	..	..	..	..	..
65	43*l*	45*l*	46*l*	50*l*	..	..	..	..	..	..	..	..	..	..	..	..
70	47*l*	48*l*	49*l*	..	..	..	..	..	..	..	..	..	..	..	..	..
75	52*l*	53*l*	54*l*	..	..	..	..	..	..	..	..	..	..	..	..	..
80	57*l*	57*l*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
85	66*l*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Ex-meridian Table No. 2.

Showing the Reduction at 1 min. from the Meridian corresponding to the A and B Corrections given on Pages 12 to 37 of this Work.

A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.
′	′	′	′	′	′	′	′	′	′	′	′	′	′
3·00	2·500	3·70	2·027	4·40	1·705	5·10	1·471	5·80	1·293	6·50	1·154	7·20	1·042
3·01	2·492	3·71	2·022	4·41	1·701	5·11	1·468	5·81	1·291	6·51	1·152	7·21	1·040
3·02	2·483	3·72	2·016	4·42	1·697	5·12	1·465	5·82	1·289	6·52	1·150	7·22	1·039
3·03	2·475	3·73	2·011	4·43	1·693	5·13	1·462	5·83	1·286	6·53	1·148	7·23	1·037
3·04	2·467	3·74	2·005	4·44	1·689	5·14	1·459	5·84	1·284	6·54	1·147	7·24	1·036
3·05	2·459	3·75	2·000	4·45	1·685	5·15	1·456	5·85	1·282	6·55	1·145	7·25	1·034
3·06	2·451	3·76	1·995	4·46	1·682	5·16	1·453	5·86	1·280	6·56	1·143	7·26	1·033
3·07	2·443	3·77	1·989	4·47	1·678	5·17	1·451	5·87	1·278	6·57	1·142	7·27	1·032
3·08	2·435	3·78	1·984	4·48	1·674	5·18	1·448	5·88	1·276	6·58	1·140	7·28	1·030
3·09	2·427	3·79	1·979	4·49	1·670	5·19	1·445	5·89	1·273	6·59	1·138	7·29	1·029
3·10	2·419	3·80	1·974	4·50	1·667	5·20	1·442	5·90	1·271	6·60	1·136	7·30	1·027
3·11	2·412	3·81	1·969	4·51	1·663	5·21	1·440	5·91	1·269	6·61	1·135	7·31	1·026
3·12	2·404	3·82	1·963	4·52	1·659	5·22	1·437	5·92	1·267	6·62	1·133	7·32	1·025
3·13	2·396	3·83	1·958	4·53	1·655	5·23	1·434	5·93	1·265	6·63	1·131	7·33	1·023
3·14	2·389	3·84	1·953	4·54	1·652	5·24	1·431	5·94	1·263	6·64	1·130	7·34	1·022
3·15	2·381	3·85	1·948	4·55	1·648	5·25	1·429	5·95	1·261	6·65	1·128	7·35	1·020
3·16	2·373	3·86	1·943	4·56	1·645	5·26	1·426	5·96	1·258	6·66	1·126	7·36	1·019
3·17	2·366	3·87	1·938	4·57	1·641	5·27	1·423	5·97	1·256	6·67	1·124	7·37	1·018
3·18	2·358	3·88	1·933	4·58	1·638	5·28	1·420	5·98	1·254	6·68	1·123	7·38	1·016
3·19	2·351	3·89	1·928	4·59	1·634	5·29	1·418	5·99	1·252	6·69	1·121	7·39	1·015
3·20	2·344	3·90	1·923	4·60	1·630	5·30	1·415	6·00	1·250	6·70	1·119	7·40	1·014
3·21	2·336	3·91	1·918	4·61	1·627	5·31	1·412	6·01	1·248	6·71	1·118	7·41	1·012
3·22	2·329	3·92	1·913	4·62	1·623	5·32	1·410	6·02	1·246	6·72	1·116	7·42	1·011
3·23	2·322	3·93	1·908	4·63	1·620	5·33	1·407	6·03	1·244	6·73	1·114	7·43	1·009
3·24	2·315	3·94	1·904	4·64	1·616	5·34	1·404	6·04	1·242	6·74	1·113	7·44	1·008
3·25	2·308	3·95	1·899	4·65	1·613	5·35	1·402	6·05	1·240	6·75	1·111	7·45	1·007
3·26	2·301	3·96	1·894	4·66	1·609	5·36	1·399	6·06	1·238	6·76	1·109	7·46	1·005
3·27	2·294	3·97	1·889	4·67	1·606	5·37	1·397	6·07	1·236	6·77	1·108	7·47	1·004
3·28	2·287	3·98	1·884	4·68	1·603	5·38	1·394	6·08	1·234	6·78	1·106	7·48	1·003
3·29	2·280	3·99	1·880	4·69	1·599	5·39	1·391	6·09	1·232	6·79	1·105	7·49	1·001
3·30	2·273	4·00	1·875	4·70	1·596	5·40	1·389	6·10	1·230	6·80	1·103	7·50	1·000
3·31	2·266	4·01	1·870	4·71	1·592	5·41	1·386	6·11	1·227	6·81	1·101	7·51	·999
3·32	2·259	4·02	1·866	4·72	1·589	5·42	1·384	6·12	1·225	6·82	1·100	7·52	·997
3·33	2·252	4·03	1·861	4·73	1·586	5·43	1·381	6·13	1·223	6·83	1·098	7·53	·996
3·34	2·246	4·04	1·856	4·74	1·582	5·44	1·379	6·14	1·221	6·84	1·096	7·54	·995
3·35	2·239	4·05	1·852	4·75	1·579	5·45	1·376	6·15	1·220	6·85	1·095	7·55	·993
3·36	2·232	4·06	1·847	4·76	1·576	5·46	1·374	6·16	1·218	6·86	1·093	7·56	·992
3·37	2·226	4·07	1·843	4·77	1·572	5·47	1·371	6·17	1·216	6·87	1·092	7·57	·991
3·38	2·219	4·08	1·838	4·78	1·569	5·48	1·369	6·18	1·214	6·88	1·090	7·58	·989
3·39	2·212	4·09	1·834	4·79	1·566	5·49	1·366	6·19	1·212	6·89	1·089	7·59	·988
3·40	2·206	4·10	1·829	4·80	1·563	5·50	1·364	6·20	1·210	6·90	1·087	7·60	·987
3·41	2·199	4·11	1·825	4·81	1·559	5·51	1·361	6·21	1·208	6·91	1·085	7·61	·986
3·42	2·193	4·12	1·820	4·82	1·556	5·52	1·359	6·22	1·206	6·92	1·084	7·62	·984
3·43	2·187	4·13	1·816	4·83	1·553	5·53	1·356	6·23	1·204	6·93	1·082	7·63	·983
3·44	2·180	4·14	1·812	4·84	1·550	5·54	1·354	6·24	1·202	6·94	1·081	7·64	·982
3·45	2·174	4·15	1·807	4·85	1·546	5·55	1·351	6·25	1·200	6·95	1·079	7·65	·980
3·46	2·168	4·16	1·803	4·86	1·543	5·56	1·349	6·26	1·198	6·96	1·078	7·66	·979
3·47	2·161	4·17	1·799	4·87	1·540	5·57	1·346	6·27	1·196	6·97	1·076	7·67	·978
3·48	2·155	4·18	1·794	4·88	1·537	5·58	1·344	6·28	1·194	6·98	1·074	7·68	·977
3·49	2·149	4·19	1·790	4·89	1·534	5·59	1·342	6·29	1·192	6·99	1·073	7·69	·975
3·50	2·143	4·20	1·786	4·90	1·531	5·60	1·339	6·30	1·190	7·00	1·071	7·70	·974
3·51	2·137	4·21	1·781	4·91	1·527	5·61	1·337	6·31	1·189	7·01	1·070	7·71	·973
3·52	2·131	4·22	1·777	4·92	1·524	5·62	1·335	6·32	1·187	7·02	1·068	7·72	·972
3·53	2·125	4·23	1·773	4·93	1·521	5·63	1·332	6·33	1·185	7·03	1·067	7·73	·970
3·54	2·119	4·24	1·769	4·94	1·518	5·64	1·330	6·34	1·183	7·04	1·065	7·74	·969
3·55	2·113	4·25	1·765	4·95	1·515	5·65	1·327	6·35	1·181	7·05	1·064	7·75	·968
3·56	2·107	4·26	1·761	4·96	1·512	5·66	1·325	6·36	1·179	7·06	1·062	7·76	·966
3·57	2·101	4·27	1·756	4·97	1·509	5·67	1·323	6·37	1·177	7·07	1·061	7·77	·965
3·58	2·095	4·28	1·752	4·98	1·506	5·68	1·320	6·38	1·176	7·08	1·059	7·78	·964
3·59	2·089	4·29	1·748	4·99	1·503	5·69	1·318	6·39	1·174	7·09	1·058	7·79	·963
3·60	2·083	4·30	1·744	5·00	1·500	5·70	1·316	6·40	1·172	7·10	1·056	7·80	·962
3·61	2·078	4·31	1·740	5·01	1·497	5·71	1·313	6·41	1·170	7·11	1·055	7·81	·960
3·62	2·072	4·32	1·736	5·02	1·494	5·72	1·311	6·42	1·168	7·12	1·053	7·82	·959
3·63	2·066	4·33	1·732	5·03	1·491	5·73	1·309	6·43	1·166	7·13	1·052	7·83	·958
3·64	2·060	4·34	1·728	5·04	1·488	5·74	1·307	6·44	1·165	7·14	1·050	7·84	·957
3·65	2·055	4·35	1·724	5·05	1·485	5·75	1·304	6·45	1·163	7·15	1·049	7·85	·955
3·66	2·049	4·36	1·720	5·06	1·482	5·76	1·302	6·46	1·161	7·16	1·047	7·86	·954
3·67	2·044	4·37	1·716	5·07	1·479	5·77	1·300	6·47	1·159	7·17	1·046	7·87	·953
3·68	2·038	4·38	1·712	5·08	1·476	5·78	1·298	6·48	1·157	7·18	1·045	7·88	·952
3·69	2·033	4·39	1·708	5·09	1·473	5·79	1·295	6·49	1·156	7·19	1·043	7·89	·951

Ex-meridian Table No. 2.

Showing the Reduction at 1 min. from the Meridian corresponding to the A and B Corrections given on Pages 12 to 37 of this Work.

A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.	A and B Cor.	Reduction.
′	′	′	′	′	′	′	′	′	′	′	′	′	′
7·90	·949	9·20	·815	10·60	·708	12·00	·625	19·00	·395	26·00	·288	78·0	·096
7·91	·948	9·22	·813	10·62	·706	12·10	·620	19·10	·393	26·10	·287	79·0	·095
7·92	·947	9·24	·812	10·64	·705	12·20	·615	19·20	·391	26·20	·286	80·0	·094
7·93	·946	9·26	·810	10·66	·704	12·30	·610	19·30	·389	26·30	·285	81·0	·093
7·94	·945	9·28	·808	10·68	·702	12·40	·605	19·40	·387	26·40	·284	82·0	·091
7·95	·943	9·30	·806	10·70	·701	12·50	·600	19·50	·385	26·50	·283	83·0	·090
7·96	·942	9·32	·805	10·72	·700	12·60	·595	19·60	·383	26·60	·282	84·0	·089
7·97	·941	9·34	·803	10·74	·698	12·70	·591	19·70	·381	26·70	·281	85·0	·088
7·98	·940	9·36	·801	10·76	·697	12·80	·586	19·80	·379	26·80	·280	86·0	·087
7·99	·939	9·38	·800	10·78	·696	12·90	·581	19·90	·377	26·90	·279	87·0	·086
8·00	·938	9·40	·798	10·80	·694	13·00	·577	20·00	·375	27·00	·278	88·0	·085
8·02	·935	9·42	·796	10·82	·693	13·10	·573	20·10	·373	27·10	·277	89·0	·084
8·04	·933	9·44	·794	10·84	·692	13·20	·568	20·20	·371	27·20	·276	90·0	·083
8·06	·931	9·46	·793	10·86	·691	13·30	·564	20·30	·369	27·30	·275	91·0	·082
8·08	·928	9·48	·791	10·88	·689	13·40	·560	20·40	·368	27·40	·274	92·0	·082
8·10	·926	9·50	·789	10·90	·688	13·50	·556	20·50	·366	27·50	·273	93·0	·081
8·12	·924	9·52	·788	10·92	·687	13·60	·551	20·60	·364	27·60	·272	94·0	·080
8·14	·921	9·54	·786	10·94	·686	13·70	·547	20·70	·362	27·70	·271	95·0	·079
8·16	·919	9·56	·785	10·96	·684	13·80	·543	20·80	·361	27·80	·270	96·0	·078
8·18	·917	9·58	·783	10·98	·683	13·90	·540	20·90	·359	27·90	·269	97·0	·077
8·20	·915	9·60	·781	11·00	·682	14·00	·536	21·00	·357	28·0	·268	98·0	·077
8·22	·912	9·62	·780	11·02	·681	14·10	·532	21·10	·355	29·0	·259	99·0	·076
8·24	·910	9·64	·778	11·04	·679	14·20	·528	21·20	·354	30·0	·250	100·0	·075
8·26	·908	9·66	·776	11·06	·678	14·30	·524	21·30	·352	31·0	·242	110·0	·068
8·28	·906	9·68	·775	11·08	·677	14·40	·521	21·40	·350	32·0	·234	120·0	·063
8·30	·904	9·70	·773	11·10	·676	14·50	·517	21·50	·349	33·0	·227	130·0	·058
8·32	·901	9·72	·772	11·12	·674	14·60	·514	21·60	·347	34·0	·221	140·0	·054
8·34	·899	9·74	·770	11·14	·673	14·70	·510	21·70	·346	35·0	·214	150·0	·050
8·36	·897	9·76	·768	11·16	·672	14·80	·507	21·80	·344	36·0	·208	160·0	·047
8·38	·895	9·78	·767	11·18	·671	14·90	·503	21·90	·342	37·0	·203	170·0	·044
8·40	·893	9·80	·765	11·20	·670	15·00	·500	22·00	·341	38·0	·199	180·0	·042
8·42	·891	9·82	·764	11·22	·668	15·10	·497	22·10	·339	39·0	·192	190·0	·039
8·44	·889	9·84	·762	11·24	·667	15·20	·493	22·20	·338	40·0	·188	200·0	·038
8·46	·887	9·86	·761	11·26	·666	15·30	·490	22·30	·336	41·0	·183	210·0	·036
8·48	·884	9·88	·759	11·28	·665	15·40	·487	22·40	·335	42·0	·179	220·0	·034
8·50	·882	9·90	·758	11·30	·664	15·50	·484	22·50	·333	43·0	·174	230·0	·033
8·52	·880	9·92	·756	11·32	·663	15·60	·481	22·60	·332	44·0	·170	240·0	·031
8·54	·878	9·94	·755	11·34	·661	15·70	·478	22·70	·330	45·0	·167	250·0	·030
8·56	·876	9·96	·753	11·36	·660	15·80	·475	22·80	·329	46·0	·163	260·0	·029
8·58	·874	9·98	·752	11·38	·659	15·90	·472	22·90	·328	47·0	·160	270·0	·028
8·60	·872	10·00	·750	11·40	·658	16·00	·469	23·00	·326	48·0	·156	280·0	·027
8·62	·870	10·02	·749	11·42	·657	16·10	·466	23·10	·325	49·0	·153	290·0	·026
8·64	·868	10·04	·747	11·44	·656	16·20	·463	23·20	·323	50·0	·150	300·0	·025
8·66	·866	10·06	·746	11·46	·654	16·30	·460	23·30	·322	51·0	·147	310·0	·024
8·68	·864	10·08	·744	11·48	·653	16·40	·457	23·40	·321	52·0	·144	320·0	·023
8·70	·862	10·10	·743	11·50	·652	16·50	·455	23·50	·319	53·0	·142	340·0	·022
8·72	·860	10·12	·741	11·52	·651	16·60	·452	23·60	·318	54·0	·139	360·0	·021
8·74	·858	10·14	·740	11·54	·650	16·70	·449	23·70	·316	55·0	·136	380·0	·020
8·76	·856	10·16	·738	11·56	·649	16·80	·446	23·80	·315	56·0	·134	400·0	·019
8·78	·854	10·18	·737	11·58	·648	16·90	·444	23·90	·314	57·0	·132	420·0	·018
8·80	·852	10·20	·735	11·60	·647	17·00	·441	24·00	·313	58·0	·129	440·0	·017
8·82	·850	10·22	·734	11·62	645	17·10	·439	24·10	·311	59·0	·127	460·0	·016
8·84	·848	10·24	·732	11·64	·644	17·20	·436	24·20	·310	60·0	·125	480·0	·016
8·86	·847	10·26	·731	11·66	·643	17·30	·434	24·30	·309	61·0	·123	500·0	·015
8·88	·845	10·28	·730	11·68	·642	17·40	·431	24·40	·307	62·0	·121	520·0	·014
8·90	·843	10·30	·728	11·70	·641	17·50	·429	24·50	·306	63·0	·119	540·0	·014
8·92	·841	10·32	·727	11·72	·640	17·60	·426	24·60	·305	64·0	·117	560·0	·013
8·94	·839	10·34	·725	11·74	·639	17·70	·424	24·70	·304	65·0	·115	580·0	·013
8·96	·837	10·36	·724	11·76	638	17·80	·421	24·80	·302	66·0	·114	600·0	·013
8·98	·835	10·38	·723	11·78	·637	17·90	·419	24·90	·301	67·0	·112	650·0	·012
9·00	·833	10·40	·721	11·80	·636	18·00	·417	25·00	·300	68·0	·110	700·0	·011
9·02	·831	10·42	·720	11·82	·635	18·10	·414	25·10	·299	69·0	·109	750·0	·010
9·04	·830	10·44	·718	11·84	·633	18·20	·412	25·20	·298	70·0	·107	800·0	·009
9·06	828	10·46	·717	11·86	·632	18·30	·410	25·30	·296	71·0	·106	900·0	·008
9·08	·826	10·48	·716	11·88	·631	18·40	·408	25·40	·295	72·0	·104	1000·0	·008
9·10	·824	10·50	·714	11·90	·630	18·50	·405	25·50	·294	73·0	·103	1200·0	·006
9·12	·822	10·52	·713	11·92	·629	18·60	·403	25·60	·293	74·0	·101	1500·0	·005
9·14	·821	10·54	·712	11·94	·628	18·70	·401	25·70	·292	75·0	·100	2000·0	·004
9·16	·819	10·56	·710	11·96	·627	18·80	·399	25·80	·291	76·0	·099	2500·0	·003
9·18	·817	10·58	·709	11·98	·626	18·90	·397	25·90	·290	77·0	·097	3000·0	·003

Table M.

ERROR IN LATITUDE DUE TO AN ERROR OF 4 SECONDS IN TIME OR 1′ OF LONGITUDE.

Azimuth.	LATITUDE.															
	0°	5°	10°	15°	18°	20°	22°	24°	26°	28°	30°	32°	34°	36°	38°	40°
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
2	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03	·03
4	·07	·07	07	·07	·07	·07	·06	·06	·06	·06	·06	·06	·06	·06	·06	·05
6	·11	·10	·10	·10	·10	·10	·10	·10	·09	·09	·09	·09	·09	·09	·08	·08
8	·14	·14	·14	·14	·13	·13	·13	·13	·13	·12	·12	·12	·12	·11	·11	·11
10	·18	·18	·17	·17	·17	·17	·16	·16	·16	·16	·15	·15	·15	·14	·14	·14
12	·21	·21	·21	·21	·20	·20	·20	·19	·19	·19	·18	·18	·18	·17	·17	·16
14	·25	·25	·25	·24	·24	·23	·23	·23	·22	·22	·22	·21	·21	·20	·20	·19
16	·29	·29	·28	·28	·27	·27	·27	·26	·26	·25	·25	·24	·24	·23	·23	·22
18	·32	·32	·32	·31	·31	·31	·30	·30	·29	·29	·28	·28	·27	·26	·26	·25
20	·36	·36	·36	·35	·35	·34	·34	·33	·33	·32	·32	·31	·30	·29	·29	·28
21	·38	·38	·38	·37	·37	·36	·36	·35	·35	·34	·33	·33	·32	·31	·30	·29
22	·40	·40	·40	·39	·38	·38	·37	·37	·36	·36	·35	·34	·33	·33	·32	·31
23	·42	·42	·42	·41	·40	·40	·39	·39	·38	·37	·37	·36	·35	·34	·33	·33
24	·45	·44	·44	·43	·42	·42	·41	·41	·40	·39	·39	·38	·37	·36	·35	·34
25	·47	·46	·46	·45	·44	·44	·43	·43	·42	·41	·40	·40	·39	·38	·37	·36
26	·49	·49	·48	·47	·46	·46	·45	·45	·44	·43	·42	·41	·40	·39	·38	·37
27	·51	·51	·50	·49	·48	·48	·47	·47	·46	·45	·44	·43	·42	·41	·40	·39
28	·53	·53	·52	·51	·51	·50	·49	·49	·48	·47	·46	·45	·44	·43	·42	·41
29	·55	·55	·55	·54	·53	·52	·51	·51	·50	·49	·48	·47	·46	·45	·44	·42
30	·58	·58	·57	·56	·55	·54	·54	·53	·52	·51	·50	·49	·48	·47	·45	·44
31	·60	·60	·59	58	·57	·56	·56	·55	·54	·53	·52	·51	·50	·49	·47	·46
32	·62	·62	·62	·60	·59	·59	·58	·57	·56	·55	·54	·53	·52	·51	·49	·48
33	·65	·65	·64	·63	·62	·61	·60	·59	·58	·57	·56	·55	·54	·53	·51	·50
34	·67	·67	·66	·65	·64	·63	·63	·62	·61	·60	·58	·57	·56	·55	·53	·52
35	·70	·70	·69	·68	·67	·66	·65	·64	·63	·62	·61	·59	·58	·57	·55	·54
36	·73	·72	·72	·70	·69	·68	·67	·66	·65	·64	·63	·62	·60	·59	·57	·56
37	·75	·75	·74	·73	·72	·71	·70	·69	·68	·67	·65	·64	·62	·61	·59	·58
38	·78	·78	·77	·75	·74	·73	·72	·71	·70	·69	·68	·66	·65	·63	·62	·60
39	·81	·81	·80	·78	·77	·76	·75	·74	·73	·72	·70	·69	·67	·66	·64	·62
40	·84	·84	·83	·81	·80	·79	·78	·77	·75	·74	·73	·71	·70	·68	·66	·64
41	·87	·87	·86	·84	·83	·82	·81	·79	·78	·77	·75	·74	·72	·70	·69	·67
42	·90	·90	·89	·87	·86	·85	·83	·82	·81	·79	·78	·76	·75	·73	·71	·69
43	·93	·93	·92	·90	·89	·88	·86	·85	·84	·82	·81	·79	·77	·75	·73	·71
44	·97	·96	·95	·93	·92	·91	·90	·88	·87	·85	·84	·82	·80	·78	·76	·74
45	1·00	1·00	·98	·97	·95	·94	·93	·91	·90	·88	·87	·85	·83	·81	·79	·77
46	1·05	1·03	1·02	1·00	·98	·97	·96	·95	·93	·91	·90	·88	·86	·84	·82	·79
47	1·07	1·07	1·06	1·04	1·02	1·01	·99	·98	·96	·95	·93	·91	·89	·87	·84	·82
48	1·11	1·11	1·09	1·07	1·06	1·04	1·03	1·01	1·00	·98	·96	·94	·92	·90	·88	·85
49	1·15	1·15	1·13	1·11	1·09	1·08	1·07	1·05	1·03	1·02	1·00	98	·95	·93	·91	·88
50	1·19	1·19	1·17	1·15	1·13	1·12	1·10	1·09	1·07	1·05	1·03	1·01	·99	·96	·94	·91
51	1·23	1·23	1·22	1·19	1·17	1·16	1·14	1·13	1·11	1·09	1·07	1·05	1·02	1·00	·97	·95
52	1·28	1·28	1·26	1·24	1·22	1·20	1·19	1·17	1·15	1·13	1·11	1·09	1·06	1·04	1·01	·98
53	1·33	1·32	1·31	1·28	1·26	1·25	1·23	1·21	1·19	1·17	1·15	1·13	1·10	1·07	1·05	1·02
54	1·38	1·38	1·36	1·33	1·31	1·29	1·28	1·26	1·24	1·22	1·19	1·17	1·14	1·11	1·08	1·05
55	1·43	1·42	1·41	1·38	1·36	1·34	1·32	1·30	1·28	1·26	1·24	1·21	1·18	1·16	1·13	1·09
56	1·48	1·48	1·46	1·43	1·41	1·39	1·37	1·35	1·33	1·31	1·28	1·26	1·23	1·20	1·17	1·14
57	1·54	1·53	1·52	1·49	1·46	1·45	1·43	1·41	1·38	1·36	1·33	1·31	1·28	1·25	1·21	1·18
58	1·60	1·59	1·58	1·55	1·52	1·50	1·48	1·46	1·44	1·41	1·39	1·36	1·33	1·29	1·26	1·23
59	1·66	1·66	1·64	1·61	1·58	1·56	1·54	1·52	1·50	1·47	1·44	1·41	1·38	1·35	1·31	1·27
60	1·73	1·73	1·71	1·67	1·65	1·63	1·61	1·58	1·56	1·53	1·50	1·47	1·44	1·40	1·36	1·33
61	1·80	1·80	1·78	1·74	1·72	1·71	1·67	1·65	1·62	1·59	1·56	1·53	1·50	1·46	1·42	1·38
62	1·88	1·87	1·85	1·82	1·79	1·77	1·74	1·72	1·69	1·66	1·63	1·59	1·56	1·52	1·48	1·44
63	1·96	1·95	1·93	1·90	1·87	1·84	1·82	1·79	1·76	1·73	1·70	1·66	1·63	1·59	1·55	1·50
64	2·05	2·04	2·02	1·98	1·95	1·93	1·90	1·87	1·84	1·81	1·78	1·74	1·70	1·66	1·62	1·57
65	2·14	2·14	2·11	2·07	2·04	2·02	1·99	1·96	1·93	1·89	1·86	1·82	1·78	1·74	1·69	1·64
66	2·25	2·24	2·21	2·17	2·14	2·11	2·08	2·05	2·02	1·98	1·95	1·90	1·86	1·82	1·77	1·72
67	2·36	2·35	2·32	2·28	2·24	2·21	2·18	2·15	2·12	2·08	2·04	2·00	1·95	1·91	1·86	1·80
68	2·48	2·47	2·44	2·39	2·35	2·33	2·30	2·26	2·22	2·19	2·14	2·10	2·05	2·00	1·95	1·90
69	2·61	2·59	2·57	2·52	2·48	2·45	2·42	2·38	2·34	2·30	2·26	2·21	2·16	2·11	2·05	2·00
70	2·75	2·74	2·71	2·65	2·61	2·58	2·55	2·51	2·47	2·43	2·38	2·33	2·28	2·22	2·16	2·10

Table M.

ERROR IN LATITUDE DUE TO AN ERROR OF 4 SECONDS IN TIME OR 1′ OF LONGITUDE.

Azimuth.	LATITUDES															
	42°	44°	46°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
2	·03	·03	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02	·02
4	·05	·05	·05	·05	·05	·04	·04	·04	·04	·04	·04	·04	·04	·04	·04	·03
6	·08	·08	·07	·07	·07	·07	·07	·06	·06	·06	·06	·06	·06	·06	·05	·05
8	·10	·10	·10	·09	·09	·09	·09	·09	·08	·08	·08	·08	·08	·07	·07	·07
10	·13	·13	·12	·12	·12	·11	·11	·11	·11	·10	·10	·10	·10	·09	·09	·09
12	·16	·15	·15	·14	·14	·14	·13	·13	·13	·12	·12	·12	·12	·11	·11	·11
14	·19	·18	·17	·17	·16	·16	·16	·15	·15	·15	·14	·14	·14	·13	·13	·12
16	·21	·21	·20	·19	·19	·18	·18	·18	·17	·17	·16	·16	·16	·15	·15	·14
18	·24	·23	·23	·22	·21	·21	·20	·20	·20	·19	·19	·18	·18	·17	·17	·16
20	·27	·26	·25	·24	·24	·23	·23	·22	·22	·21	·21	·20	·20	·19	·19	·18
21	·29	·28	·27	·26	·25	·25	·24	·24	·23	·23	·22	·21	·21	·20	·20	·19
22	·30	·29	·28	·27	·27	·26	·25	·25	·24	·24	·23	·23	·22	·21	·21	·20
23	·32	·31	·29	·28	·28	·27	·27	·26	·26	·25	·24	·24	·23	·22	·22	·21
24	·33	·32	·31	·30	·29	·29	·28	·27	·27	·26	·26	·25	·24	·24	·23	·22
25	·35	·34	·32	·31	·31	·30	·29	·29	·28	·27	·27	·26	·25	·25	·24	·23
26	·36	·35	·34	·33	·32	·31	·31	·30	·29	·29	·28	·27	·27	·26	·25	·24
27	·38	·37	·35	·34	·33	·33	·32	·31	·31	·30	·29	·28	·28	·27	·26	·25
28	·40	·38	·37	·36	·35	·34	·33	·33	·32	·31	·30	·30	·29	·28	·27	·27
29	·41	·40	·39	·37	·36	·36	·35	·34	·33	·33	·32	·31	·30	·29	·29	·28
30	·43	·42	·40	·39	·38	·37	·36	·36	·35	·34	·33	·32	·31	·31	·30	·29
31	·45	·43	·42	·40	·39	·39	·38	·37	·36	·35	·34	·34	·33	·32	·31	·30
32	·46	·45	·43	·42	·41	·40	·39	·38	·38	·37	·36	·35	·34	·33	·32	·31
33	·48	·47	·45	·43	·43	·42	·41	·40	·39	·38	·37	·36	·35	·34	·33	·32
34	·50	·49	·47	·45	·44	·43	·42	·42	·41	·40	·39	·38	·37	·36	·35	·34
35	·52	·50	·49	·47	·46	·45	·44	·43	·42	·41	·40	·39	·38	·37	·36	·35
36	·54	·52	·50	·49	·48	·47	·46	·45	·44	·43	·42	·41	·40	·39	·37	·36
37	·56	·54	·52	·50	·49	·48	·47	·46	·45	·44	·43	·42	·41	·40	·39	·38
38	·58	·56	·54	·52	·51	·50	·49	·48	·47	·46	·45	·44	·43	·41	·40	·39
39	·60	·58	·56	·54	·53	·52	·51	·50	·49	·48	·46	·45	·44	·43	·42	·40
40	·62	·60	·58	·56	·55	·54	·53	·52	·51	·49	·48	·47	·46	·44	·43	·42
41	·65	·63	·60	·58	·57	·56	·55	·54	·52	·51	·50	·49	·47	·46	·45	·43
42	·67	·65	·63	·60	·59	·58	·57	·55	·54	·53	·52	·50	·49	·48	·46	·45
43	·69	·67	·65	·62	·61	·60	·59	·57	·56	·55	·53	·52	·51	·49	·48	·47
44	·72	·69	·67	·65	·63	·62	·61	·59	·58	·57	·55	·54	·53	·51	·50	·48
45	·74	·72	·69	·67	·66	·64	·63	·62	·60	·59	·57	·56	·54	·53	·52	·50
46	·77	·74	·72	·69	·68	·67	·65	·64	·62	·61	·59	·58	·56	·55	·53	·52
47	·80	·77	·74	·72	·70	·69	·67	·66	·65	·63	·62	·60	·58	·57	·55	·54
48	·83	·80	·77	·74	·73	·71	·70	·68	·67	·65	·64	·62	·60	·59	·57	·56
49	·85	·83	·80	·77	·75	·74	·72	·71	·69	·68	·66	·64	·63	·61	·59	·58
50	·89	·86	·83	·80	·78	·77	·75	·73	·72	·70	·68	·67	·65	·63	·61	·60
51	·92	·89	·86	·83	·81	·79	·78	·76	·74	·73	·71	·69	·67	·65	·64	·62
52	·95	·92	·89	·86	·84	·82	·81	·79	·77	·75	·73	·72	·70	·68	·66	·64
53	·99	·95	·92	·89	·87	·85	·84	·82	·80	·78	·76	·74	·72	·70	·68	·66
54	1·02	·99	·96	·92	·90	·88	·87	·85	·83	·81	·79	·77	·75	·73	·71	·69
55	1·06	1·03	·99	·96	·94	·92	·90	·88	·86	·84	·82	·80	·78	·76	·74	·71
56	1·10	1·07	1·03	·99	·97	·95	·93	·91	·89	·87	·85	·83	·81	·79	·76	·74
57	1·14	1·11	1·07	1·03	1·01	·99	·97	·95	·93	·91	·88	·86	·84	·82	·79	·77
58	1·19	1·15	1·11	1·07	1·05	1·03	1·01	·99	·96	·94	·92	·89	·87	·85	·82	·80
59	1·24	1·20	1·16	1·11	1·09	1·07	1·05	1·02	1·00	·98	·95	·93	·91	·88	·86	·83
60	1·29	1·25	1·20	1·16	1·14	1·11	1·09	1·07	1·04	1·02	·99	·97	·94	·92	·89	·87
61	1·34	1·30	1·25	1·21	1·18	1·16	1·14	1·11	1·09	1·06	1·05	1·01	·98	·96	·93	·90
62	1·40	1·35	1·31	1·26	1·23	1·21	1·18	1·16	1·13	1·11	1·08	1·05	1·02	1·00	·97	·94
63	1·46	1·41	1·36	1·31	1·29	1·26	1·24	1·21	1·18	1·15	1·13	1·10	1·07	1·04	1·01	·98
64	1·52	1·47	1·42	1·37	1·34	1·32	1·29	1·26	1·23	1·21	1·18	1·15	1·12	1·09	1·06	1·03
65	1·59	1·54	1·49	1·43	1·41	1·38	1·35	1·32	1·29	1·26	1·23	1·20	1·17	1·14	1·10	1·07
66	1·67	1·62	1·56	1·50	1·47	1·44	1·41	1·38	1·35	1·32	1·29	1·26	1·22	1·19	1·16	1·12
67	1·75	1·69	1·64	1·58	1·55	1·51	1·48	1·45	1·42	1·38	1·35	1·32	1·28	1·25	1·21	1·18
68	1·84	1·78	1·72	1·66	1·62	1·59	1·56	1·52	1·49	1·45	1·42	1·38	1·35	1·31	1·27	1·24
69	1·94	1·87	1·81	1·74	1·71	1·67	1·64	1·60	1·57	1·53	1·49	1·46	1·42	1·38	1·34	1·30
70	2·04	1·98	1·91	1·84	1·80	1·77	1·73	1·69	1·65	1·61	1·58	1·54	1·50	1·46	1·41	1·37

"SUMNER'S" POSITION FROM TWO EX-MERIDIAN SUN OBSERVATIONS, USING EX-MERIDIAN TABLE No. 1.

1898.—On 17th April, a.m. at ship at sea, when a chronometer indicated M.T. Green. 16 d. 23 h. 31 m. 30 s., the true altitude of sun's centre was 67° 17′ 47″ N.; and again on the same afternoon when a chronometer indicated M.T. Green. 17 d. 0 h. 50 m. 52 s., the true altitude of sun's centre was 67° 4′ 56″ N., the ship having made 16 miles on a true S. 35° E. course during the interval between the observations. Required, the position of ship when 2nd observation was taken, assuming D.R. lat. to be 9° 45′ S., and long. 2° 45′ W., when 1st observation was taken.

1st Observation (a.m. at ship).

	D. H. M. S.
M.T. G.	16 23 31 30
Long. W	− 11 0
M.T. Sp.	16 23 20 30
Eq. T.	+ 30
A.T. Sp.	16 23 21 0
H.A.	E. 0 39 0

	° ′ ″
Decl.	10 34 58 N
52·6″ × ·48 h. =	25 S
Cor. dl.	10 34 33 N

	M. S.
Eq. T.	0 30·77
·58 s. × ·48 h.	− ·27
Cor. Eq. T.	0 30·5

	° ′ ″
T. alt. −⊖−	67 17·8 N
Redn.	2 10·3
Mer. alt.	69 28·1
M Z D	20 31·9 S
Decl.	10 34·6 N
Lat.	9 57·3 S
Run. d. lat.	13·1 S
Lat. at time of 2nd obsn.	10 10·4 S

	M.	S.	E.
Run, S 35° E	16 =	13·1	9·2 = 9·34 d. long.

	° ′ ″	
Long.	2 45 0	W
d. long.	− 9 20	E
Long. at 2nd obsn.	2 35 40	W = 10 22·7.

For Azimuth by Table D.

Lat. (dec.) 10·6°, Az. (H.A.) 39 m. = 92½°, M = 24·0
Lat. (alt.) 67·3°, and M 24·0 gives Az. 25·5°

For Reduction.

Az. 25·5° (p. 41) gives A and B cor. = 2·13′, which gives redn. at 1 m. (p. 144), 3·34′ × 39 m. = 130·26′ = 2° 10·3′ redn.

2nd Observation (p.m.).

	D. H. M. S.
M.T. G.	17 0 50 52
Long. W	− 10 23
M.T. Sp.	17 0 40 29
Eq. T.	+ 31
A.T. Sp.	17 0 41 0

	° ′ ″
Decl.	10 34 58 N
52·6″ × ·85 h. =	45 N
Cor. dl.	10 35 43 N

	M. S.
Eq. T.	0 0·77
·6 s. × ·85 h.	+ ·51
Cor. Eq. T.	0 31·28

	° ′
T. alt. −⊖−	67 4·9 N
Redn.	2 23·5
Mer. alt.	69 28·4
M Z D	20 31·6 S
Decl.	10 35·7 N
Lat.	9 55·9 S

For Azimuth by Table D.

Lat. (dec.) 10·6°, Az. (H.A.) 41 m. = 10¼°, M = ·8.
Lat. (alt.) 67·1 and M 22·8 = Az. 26·7°.

For Reduction.

Az. 26·7° (p. 41) gives A and B cor. 2·02′, which gives (p. 144) redn. at 1 m., 3·50′ × 41 m. = 143·5 = 2° 23·5′ redn.

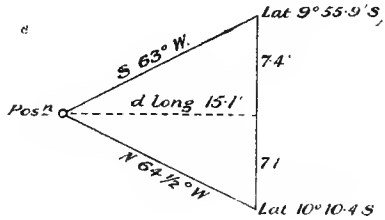


Table M.

1st obsn. Az. 25·5 and Lat. 10° 10′·4 S ·47 N to W
2nd obsn. Az. 26·7 and Lat. 9 55·9 S ·49 S to W

Lat. diff. 14·5 ÷ ·96 = cor. for Long. 15·1 W ×
·47
Lat. cor. 7·1 N

	° ′		° ′
Lat.	10 10·4 S	Long.	2 35·7 W
Cor.	7·1 N	Cor.	15·1 W
Lat. in	10 3·3 S	Long. in	2 50·8 W

As a check on the correctness of the previous work and position found from chart, apply the longitude now found from the observations to the Green. time, also the equation of time, and with the hour-angle thus found again take out the reduction.

	D. H. M. S.
M.T. G.	17 0 50 52
Long. W.	− 11 23
	17 0 39 30
Eq. T.	+ 31
A.T. Sp.	17 0 40 0

	°		′
Dl.	10·6 N		
Lat.	10·0 S	A	1·00 N
H.A.	40 m.	B	1·08 N
		C	2·08 N gives

Redn. at 1 m. = 3·41′ × 40 m. = redn. 136·4′ = 2° 16·4′.

	° ′
T. alt. −⊖−	67 4·9 N
Redn.	2 16·4
Mer. alt.	69 21·3
M Z D	20 38·7 S
Decl.	10 35·7 N
Lat.	10 3·0 S

A rigorous calculation by spherical trigonometry gives latitude 10° 3′ 5″ S., and taking this latitude and the altitude and declination at time of 2nd observation the resulting longitude was found by calculation of the H.A. to be 2° 50′ 40″ W., which confirms the position as being practically correct.

"SUMNER" POSITION FROM A.M. AND P.M. SUN OBSERVATIONS NEAR THE MERIDIAN.

1898.—On August 31st, in lat. by D.R. 7° 42′ N., long. 73° 50′ E. Obsd. alt. of ⊙'s L.L. (a.m. at ship) was 88° 50′ N. when a chronometer indicated M.T.G. 30 d. 19 h. 2 m. 53 s., and again (p.m.) the obsd. alt. of ⊙ s L.L. was 88° 44′ when chronometer indicated M.T.G. 30 d. 19 h. 7 m. 57 s. Run in interval, N. 80° W., 1 m., gives 0·2′ N., 1·0′ W. Height of eye, 35 ft. Required, posn. of ship by "Sumner's" method from ex-meridian tables.

A.M. Observation.

	D. H. M. S.
M.T. Green.	30 19 2 53
Long. 73° 50′ E	4 55 20
M.T. at ship	23 58 13
Eq. time	− 13
A.T. Sp.	23 58 0
H.A.	E. 2 0

	° ′
Obsd. alt. ⊙'s L.L.	88 50 N E
Cor. 35 ft. (p. 87)	+ 10
True alt. −⊖−	89 0

	° ′ ″
Decl. 31st	8 33 0 N
54′·4 × 5 h.	+ 4 32
Decl.	8 37 32 N

	M. S.
Eq. of time	0 9·36
·78 s. × 5 h.	3·9
Cor. Eq. T.	0 13·26

For Azimuth.

H.A.	2 m.	Sin.	7·9408
Decl.	8° 37½′	Cos	9·9951
Alt.	89°	Sec.	1·7581
Az.	29° 37½′	Sin.	9·6940

gives (p. 40) A & B 1·78′ gives (p. 75) position-line for plane chart N 60·7° W.

For Reduction (from Blackburne's and Westland's Reduction Table No. 3).

Az.	29·6°	Arc cor.	° ′ 7·8
Alt.	89° N	Z D	1 0·0 S
Z D	1° S		
Arc (2)			0 52·2 S
" (1), decl.			8 37·5 N
Lat.			7 45·3 N
Run			·2 N
Lat. at 2nd obsn.			7 45·5 N

P.M. Observation.

	D. H. M. S.
M.T. Green.	30 19 7 57
Long. 73° 49′ E	+ 4 55 16
M.T. at Sp.	31 0 3 12
Eq. T.	− 13
A.T. Sp.	31 0 3 0
H.A.	W. 3 0

	° ′
Obsd. alt. ⊙'s L.L.	88 44 N Wd
35 ft. cor.	+ 10
T. alt. −⊖−	88 54 N

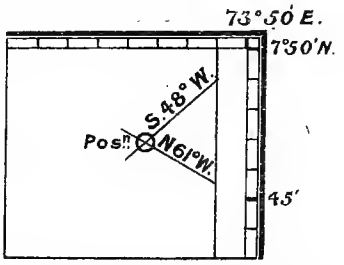
For Azimuth.

H.A.	3 m.	Sin.	8·1169
Dl.	8° 37½′	Cos.	9·9951
Alt.	88° 54′	Sec.	1·7168
Az.	42° 24′	Sin.	9·8288

gives (p. 40) A & B 1·11′ gives (p. 75) position-line for plane chart N 48° E, or S 48° W.

For Reduction.

Az.	42·4°	Arc cor.	° ′ 0 17·3
Alt.	88° 54′ N	Z D	1 6·0 S
Z D	1° 6′ S		
Arc (2)			0 48·7 S
" (1) decl.			8 37·5 N
Lat.			7 48·8 N



Position from chart: Latitude 7° 46¾′ N., longitude 73° 46¾′ E.

NOTE.—The long. by chron. at 2nd observation, calculated with this lat. found from the two observations, was 73° 46′ 30″ E., and the lat. reworked from the H.A. resulting from this long. was 7° 47′ N.

IMPROVED "SUMNER" POSITION FROM TWO STELLAR OBSERVATIONS

(Combining Chron. Long. Observation with an Ex-meridian below the Pole).

1898.—On October 8th, at about 6h. 44m. p.m. A.T. at ship, observed altitude of * Canopus east of meridian was 15° 14′ S., when a chronometer indicated mean time at Greenwich 7d. 19h. 36m. 16s., and after running on a true S. 55° E. course for three-quarters of a mile observed altitude of * Fomalhaut to north-eastward was 49° 20′, when chronometer indicated 7d. 19h. 40m. 6s. Height of eye, 28ft. Required, true bearing of stars and position of ship at time of *second* observation, the approximate position at the time being latitude 51° S. and longitude 163° E.

* Canopus to South-eastward.

	D. H. M. S.
M.T.G.	7 19 36 20
Long. 162° 59′ E.	+ 10 51 56
M.T. Sp.	8 6 28 16
M. ☉'s R.A.	+ 13 7 50·2
Sid. T. at Sp.	19 36 6·2
*'s R.A.	6 21 43
H.A.	13 14 23·2 W.
Supt.	1 14 23·2 E.

H.A. at *Inferior* Transit.

Az. from Table* S. 11½° E.

Position-line N. 78½° E.

	° ′
Obsd. alt. * Canopus	15 14·0 S.
Cor. 28 ft.	− 8·7
True alt.	15 5·3 S.
Redn. from Table*	− 1 10·8
Mer. alt.	13 54·5 S.
P. Dist.	37 22·0 S.
Lat.	51 16·5 S.
Run	0·4 S.
Lat. at 2nd obsn.	51 16·9 S.

	H. M. S.
Sid. T. (G. noon)	13 4 37·0
Accl. 19h. 36⅔m.	+ 3 13·2
M. ☉'s R.A.	13 7 50·2
*'s Decl.	° ′ 52 38 S.
P. Dist.	37 22 S.

Run S. 55° E., 0·75 m. = 0·4′ S., 0·6′ E. = 1·0′ E.

* Fomalhaut to North-eastward.

	D. H. M. S.
M.T.G.	7 19 40 6
Sid. Time	+ 13 4 37
Accl.	+ 3 13·9
Sid. T.G.	8 47 56·9

	° ′
Obsd. alt. of * Fomalhaut	49 20·0
Cor. 28ft.	− 6·0
True alt.	49 14·0

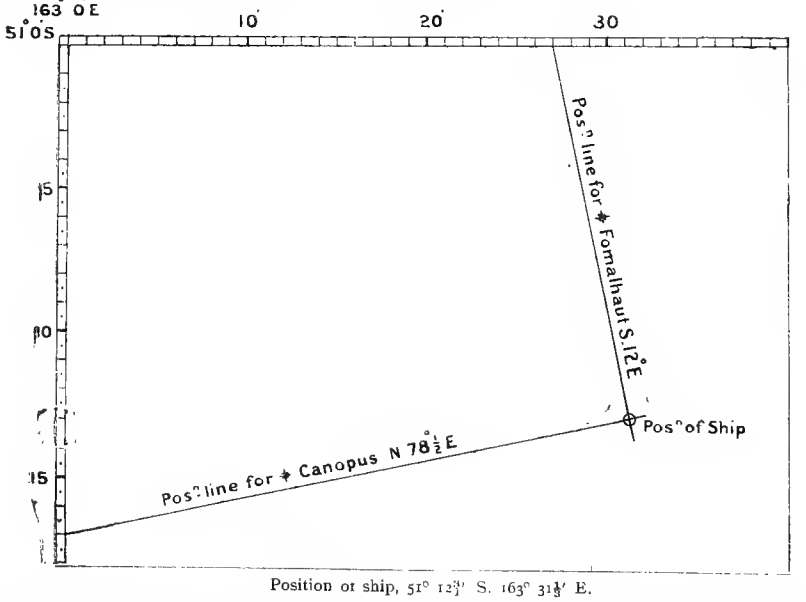
	° ′ ″
*'s Decl.	30 9 24 S.
P. Dist.	59 50 36

	° ′		
A	49 14		
L	51 0	Sec	0·20113
P	59 51	Cosec	0·06313
	160 5		
S	80 2½	Cos	9·23787
S − A	30 48½	Sin	9·70941
		Sin²	9·21154

	H. M. S.
*'s H.A.	− 3 10 20·6 E.
*'s R.A.	22 52 5·7
Sid. T. at Ship	19 41 45·1
Sid. T. at Green	8 47 57
Long in Time	10 53 48
Longitude	163° 27′ 0″ E.

	′	
A	1·13	N.
B	0·79	S.
C	0·34	N. gives Azimuth N. 78° E.

Position-line S. 12° E.



Position of ship, 51° 12¾′ S. 163° 31⅓′ E.

Note.—As time is often lost in getting hold of the log-book and working up the D.R. position, this example is worked with the nearest whole degree of latitude and longitude, and this will generally be near enough for a pretty accurate result when working by the improved "Sumner" method.

This problem worked closely by spherics gives within ¼′ of same result.

* Blackburne's and Westland's Reduction and Azimuth Tables.

TO FIND APPROXIMATE ALTITUDES AND BEARINGS OF SUITABLE STARS FOR OBSERVATION TO QUICKLY OBTAIN POSITION OF SHIP.

1908.—On April 2nd, in lat. by D.R. 60° N. long. 15° W., soon after sunset (about 6 h 45 m p.m.), find the approximate altitudes and bearings of two suitable below-Pole ex-meridian stars for readily finding the ship's position by observation. Height of eye, 40 ft.

On p. 9 it will be seen that α Cygni passes the meridian (below Pole) at H. M. 7 53 p.m. and Vega at H. M. 5 49 p.m.
A.T. Sp. 6 40 p.m. 7 0

Approx. H.A.s 1 13 W 1 11 E

Reduction and Azimuth Table (pp. 122 and 120) gives redn. 63·5′ and Az. N 13·3° W. Redn. 64·7′ and Az. N 14·0° E.

∗ α Cygni (Decl.)	° ′ 44 56·8 N	∗ Vega (Decl.)	° ′ 38 41·6 N
P.D.	45 3·2	P.D.	51 18·4
Lat.	60 0·0	Lat.	60 0·0
Mer. alt. of ∗	14 56·8	Mer. alt.	8 41·6
40 ft. cor.	+ 9·5	40 ft.	+ 11·6
Redn.*	1 3·5	Redn.*	1 4·7
Approx. alt.	16 9·8 Az. N 13° W.	Approx. alt.	10 7·9 Az. N 14° E.

POSITION FROM TWO EX-MERIDIAN STELLAR OBSERVATIONS.

1908.—On 2nd April, soon after sunset, at about 6 h. 37 m. and 6 h. 59 m. p.m., in latitude by D.R. 60° 5′ N., longitude 15° 15′ W., the observed altitude of ∗ α Cygni was 16° 12′ N.W. when a chronometer indicated M.T.G. 7 h. 41 m. 12 s.; after running on a true east course 4½ miles observed altitude of ∗ Vega 10° 2′ N.E. when a chronometer indicated M.T.G. 8h. 3m. 21s. Height of eye, 40 ft. Required position of ship at time of second observation.

1st Observation (∗ α Cygni to N. Wd.)

	H. M. S.		H. M. S.		° ′
M.T.G.	7 41 12	Sid. T. (G. noon)	0 41 43	Obsd. alt. of ∗	16 12·0 N
Long. 15° 15′ W	− 1 1 0	Accl. 7h 41m	+ 1 15·5	40 ft.	− 9·5
M.T. at Sp.	6 40 12	M. ⊙'s R.A.	0 42 58·5 (1st obsn.)	T. alt.	16 2·5
M. ⊙'s R.A.	+ 0 42 58	22m	+ 3·6	Reduction	− 1 7·2
Sid. T. at Sp.	7 23 10	M. ⊙'s R.A.	0 43 2·1 (2nd obsn.)	Mer. alt.	14 55·3 N
∗'s R.A.	20 38 17			∗'s P.D.	45 3·2 N
∗'s H.A.	10 44 53 W	Gives from Reduction and Azimuth Table (p. 122) of Blackburne's and Westland's Reduction Tables.		Lat.	59 58·5 N
Supt.	1 15 7				

Reduction 1° 7·2′ Az. N 13·7° W or posn.-line N 76·3° E.

2nd Observation (∗ Vega to N. Ed.)

	H. M. S.		° ′		° ′
M.T.G.	8 3 21	Run east 4·5 = d. long.	9·0 E	Obsd. alt. of ∗	10 2·0 N
Long. 15° 6′ W	1 0 24	Long. at 1st obsn.	15 15·0 W	40 ft. cor.	− 11·6
M.T. at Sp.	7 2 57	Long. at 2nd obsn.	15 6·0 E	True alt.	9 50·4
M. ⊙'s R.A.	0 43 2			Redn.	1 6·8
M.T. at Sp.	7 45 59			Mer. alt.	8 43·6 N
∗'s R.A.	18 33 49	Reduction from Table (p. 120) 1° 6·8′. Azimuth N 14·2° E or posn-line S 76° E.		∗'s P.D.	51 18·4 N
∗'s H.A.	10 47 50 E			Lat.	60 2·0 N
Supt.	1 12 10				

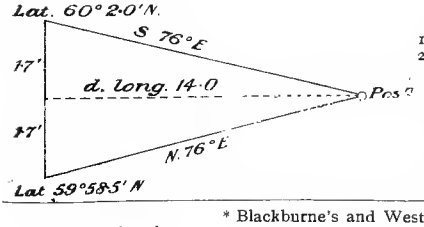


Table M (p. 151).

1st obsn. Az. 13°·7 and lat. 59° 58′·5 N ·12 N to E
2nd obsn. Az. 14·2 and lat. 60 2·0 N ·13 S to E

d. lat. 3′·5 ÷ ·25 = long. cor. 14·0′ E × ·12 = lat. cor. 1·68′ N.

	° ′		° ′
Lat.	59 58·5 N	Long.	15 6 W
Cor.	1·7 N	Cor.	14 E
Lat. in	60 0·2 N	Long. in	14 52 W

* Blackburne's and Westland's Reduction and Azimuth Tables.

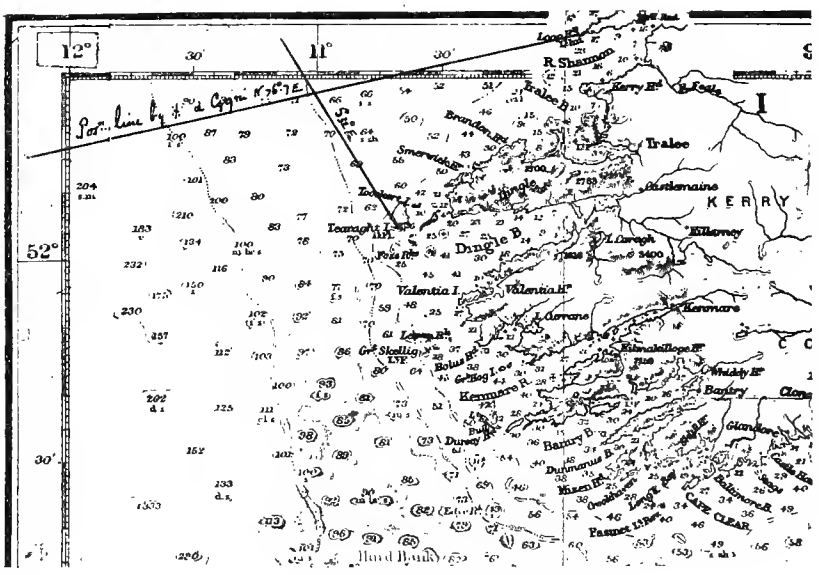
BELOW POLE EX-MERIDIAN AND POSITION-LINE.

1910.—On April 1st, soon after sunset, at 6h. 42m. p.m., observed altitude of * α Cygn (Deneb) 8° 46′ W. of meridian when a chronometer indicated mean time at Greenwich 7h. 34m. 13s. Approximate latitude 52° N., and longitude 12° W. Required, latitude of meridian, and position-line from it.

* α CYGNI TO NORTHWARD.

	H. M. S.		H. M. S.		° ′
M.T. Green.	7 34 13	Sid. T. (G. noon)	0 35 51·6	Obsd. alt. of *	8 46·0 N.
Long. 12° W.	− 48 0	Accl. 7h. 34m.	+ 1 14·6	Cor. (40ft.)	− 12·3
M.T. Sp.	6 46 13	M. ⊙'s R.A.	0 37 6·2	T. alt.	8 33·7
M. ⊙'s R.A.	+ 0 37 6			Redn.*	− 1 20·2
Sid. T. at Sp.	7 23 19			Mer. alt.	7 13·5 N.
*'s R.A.	20 38 21			P.D.	45 2·9 N.
*'s H.A.	13 15 2 W.	Azimuth from table*	N. 13·3 W.	Lat.	52 16·4 N.
Supt.	1 15 2 E.		90·0	Cor. for 16′	+ 0·4
		Position-line	N. 76·7 E.	Lat.	52 16·8 N.

H.A. at *Inferior* Transit.



The above example is given to draw special attention to the great value of the ex-meridian problem when near the meridian below the pole. The observation gives with α minimum amount of work (when within the limits of these tables) the latitude on a certain meridian, and the position-line from this meridian. The curvature of this position-line is seen at a glance from the azimuth table, which is given on the same page as the reduction table. In this example the change of azimuth only amounts to 0·7 of a degree in 4m. of time, or 1° of longitude.

The position-line at Loop Head would be N. 78° E.

This position-line crossed by a bearing of Tearaght Island light (if sighted) would give a good reliable position, provided the observation was good. A sounding in conjunction with this position-line would also give a fairly accurate position.

With a trifle more labour, using ex-meridian table No. 1 and the A and B tables for the azimuth, the latitude and position-line could also have been found at the same time by * Sirius, the position-line of which would have then been S. 79° E. The crossing of these two position-lines would give an excellent latitude, but the longitude would not be reliable, as the angle is small, and both observations are west of the meridian.

* From Blackburne's and Westland's Azimuth and Reduction Tables.

POSITION BY CHRONOMETER AND EX-MERIDIAN OBSERVATIONS OF SUN AND MOON.

1898.—On March 30th, at about 1 h. 24 m. p.m., at ship, observed alt. of ☾'s U.L. was 27° 57′ east of meridian when a chronometer indicated M.T.G. 2 h. 18 m. 57 s., and after running on an east course 2 miles the ☉'s L.L. was observed to be 32° 51′ when the chronometer indicated 2 h. 26 m. 35 s. Lat. by D.R. 58° 2½′ N., long. 12° 30′ W., height of eye 35 ft.

1st Observation, ☾.

	h. m. s.
M.T. Green	30 2 18 57
Sid. T. (G. noon)	+ 31 34·8
Accl. 2 h. 19 m.	+ 22·8
Sid. T. Green.	2 50 54·6

	° ′ ″
Obsd. alt. ☾'s U.L.	27 57 0
Dip. 35 ft.	− 5 50
	27 51 10
Semi-d.	− 14 58
App. alt. ☾'s centre	27 36 12
Cor. T. 39, Raper H.P. 54′ 16″	+ 46 15
T. alt. ☾'s centre	28 22 27

A	28 22½		
L	58 2½	Sec.	0·27630
P	66 15	Cosec.	0·03843
	152 40		
S	76 20	Cos.	9·37341
S − A	47 57½	Sin.	9·87079

	h. m. s.
☾'s R.A. 2 hrs.	6 55 51·6
2·13 s. × 19 m.	+ 40·5
Cor. R.A.	6 56 32·1

	h. m. s.		
H.A.	4 56 0	Hav.	9·55893
☾'s R.A.	6 56 32·1		
Sid. T. Sp.	2 0 32·1		
Sid. T. G.	2 50 54·6		
Long. in time	50 22·5		
Long.	12 35 38 W.		
Run	3 48 E.		
Long. at 2nd obsn.	12 31 50 W.		
Long. in time	50 7·3		

	° ′ ″
☾'s decl. 2 hrs.	23 46 57 N.
5′44″ × 19 m.	− 1 43
Cor. decl.	23 45 14 N.
P.D.	66 14 46 N.

	′
A	·459 S.
B	·458 N.
C	·001 S.

gives Az. 90°

Run east 2 m. = d. long. 3·8′.

2nd Observation, ☉.

LAT. BY EX-MERIDIAN TABLE NO. 2.

By reference to page 147 it will be seen that with a low latitude and high declination this table may be used without appreciable error to about 2 hours from the meridian. Therefore, by transposing lat. and dec. the same wide range may be obtained. The example below illustrates this case.

	h. m. s.
M.T.G.	2 26 35
Long. W	− 50 7·3
M.T. Sp.	1 36 27·7
Eq. T.	− 4 27·0
H.A.	1 32 0·7

	° ′	′
Lat. (dec.)	3 56 N	A ·16 S.
Dec. (lat.)	58 0 N	B 4·10 N.
		C 3·94 N. gives (p. 148)

1·504′ × 92 m. = 175·168′ = 2° 55·2′ redn.

	° ′
Obsd. alt. of ☉'s L.L.	32 51 S.
35 ft. cor. (p. 87)	+ 9
T. alt.	33 0·0 S.
Redn.	2 55·2
Mer. alt.	35 55·2
M.Z.D.	54 4·8 N.
Decl.	3 55·7 N.
Lat.	58 0·5 N.

	° ′ ″
☉'s decl.	3 53 21 N.
58·2″ × 2·4 hrs.	2 20 N.
Cor. decl.	3 55 41 N.

	m. s.
Eq. time	4 28·8
·76 s. × 2·4 hrs.	− 1·8
Cor. Eq. T.	4 27·0

CORRECTNESS OF WORK BY THE ABOVE METHODS WITH EX-MERIDIAN TABLE NO 2 PROVED BY RIGOROUS CALCULATION.

	h. m.				
H.A.	1 32	Cos.	9·964026		
Decl.	3° 55′ 41″ N	Cot.	1·163267	Cosec.	1·164289
Arc (1)	° ′ ″ 4 15 58 N	Cot.	1·127293	Sin.	8·871502
		☉'s alt.	33° 0′	Sin.	9·736109
,, (2)	53 44 30 N.	.	. .	Cos.	9·771900
Lat.	58 0 28 N.				

As the moon was on the prime vertical when the altitude was taken, the time deduced from this observation should be absolutely correct, and the latitude by ex-meridian of the sun will also be correct without any additional work.

See note on page 117 about correcting moon's semidiameter and horizontal parallax for Greenwich date.

FORMULÆ FOR CALCULATION OF EX-MERIDIAN LATITUDE WHEN AZIMUTH IS KNOWN.

It will be seen from the accompanying figure that if we drop a perpendicular on the meridian from D at M the following arcs, P M arc (1), and Z M arc (2), are readily calculated. The sum or difference of arc (1) and arc (2) = latitude.

Rule for Object above the Pole.

Name arc (1) *same* as declination.
Name arc (2) *contrary* to bearing of object—*i.e.*, N. or S. of the prime vertical.
Add like and *subtract* unlike names, which will give the required latitude.

Formulæ of Calculation.

Cot. P M arc (1) = Cos H.A. × Cot. decl.
Tan Z M arc (2) = Cos. Az. × Cot. Alt.

Rule for Object below the Pole.

Name both arc (1) and arc (2) same as the decl.
Latitude = Sum of arc (1) and arc (2).

Formulæ for the Calculation.

H.A. = Supplement of H.A. from upper meridian.
For Arc (2) use comp. of Z M, or M N, then
Tan. arc (1) = Cos. H.A. × Cot. decl.
Cot. arc (2) = Cos. Az. × Cot. alt.
P M + M N = comp. P Z = latitude.

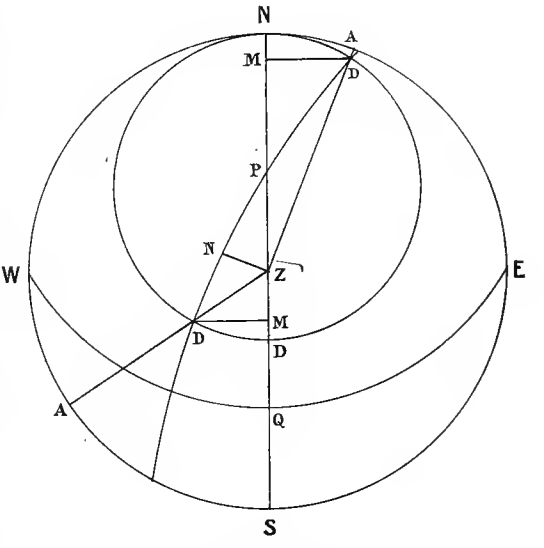


FIGURE SHOWING:

Latitude, 60° N. Declination, 30° N.
Hour-angle, 2 hours.

Arc (1), P M or comp. Q M.
Arc (2), Z M or comp. M N or M S.

Arc (1) is found by the same formula as is used on p. 97, and the same arc is used for arc (2), but with a trifle less work; and as an ex-meridian outside the ordinary limits of ex-meridian tables is seldom of much use without the azimuth, this method is recommended in preference, if the azimuth is calculated with the H.A. and altitude. This method should always be used in preference when the declination of object is small. The writer's attention was first drawn to this excellent method of obtaining the latitude by a letter to the *Nautical Magazine*, August, 1899, p. 581, from E. S. Haynes, master of the tug "Cuzuni," and the value of it has been further impressed on him by a study of Admiral Sir H. E. Purey Cust's valuable little book on "Sumner's" method. In this work Admiral Cust, R.N. (at present Hydrographer to the Admiralty), strongly advocates this method.

Formulæ to compute Altitudes.

Using the accompanying figure. From Z drop a perp. on the hour circle at N. This will be outside the usual spherical triangle when the hour-angle is over 6 h. Arc (1) = P N. Arc (2) = P D − P N = N D when H.A. is less than 6 h. Arc (2) = P D + P N when H.A. is more than 6 h. Then Tan. Arc (1) = Cos. P × Cot. Lat.

Sin. Alt. = sin. lat. × sec. arc (1) × Cos. arc (2).

H.A. 6 h = 90° *Formula.*
Sin. Alt. = sin. decl. × sin. lat.

POSITION FROM CALCULATED EX-MERIDIAN OF TWO STARS, EACH OVER FOUR HOURS FROM THE MERIDIAN OF INFERIOR TRANSIT.

1898.—On 10th Nov., at about 7 h. 25 m. p.m. A.T. at ship in lat. by D.R. 40° 30′ S. and long. 173° 0′ E. Observed altitude of ∗ Canopus was 17° 10′ to S.E. when a chronometer indicated M.T.G. 9 d. 19 h. 35 m. 28 s., and again after running east (true) for ½ m. observed altitude of ∗ α^2 Centauri 22° 51¼′ to S.W. when a chronometer indicated M.T.G. 19 h. 37 m. 48 s. Height of eye, 36 ft. Required the position of ship at the time of second observation.

1ST OBSERVATION.

	d. h. m. s.
M.T.G.	9 19 35 28
Long. 173° E	+ 11 32 0
M.T. at Sp.	7 7 28
M. ⊙'s R.A.	15 17 56·3
Sid. T. at Sp.	22 25 24·3
∗'s R.A.	6 21 44·3
∗'s H.A.	7 56 20·0
Supt.	4 3 40

	h. m. s.
Sid. T. at G. noon	15 14 43·2
Accl. 19h 35½m	+ 3 13·1
M. ⊙'s R.A. (1st obsn.)	15 17 56·3
	+ ·2
M. ⊙'s R.A. (2nd obsn.)	15 17 56·5

∗ CANOPUS TO S.ED.

	° ′
Obsd. alt. of ∗	17 10
36 ft. cor.	− 9
T. alt.	17 1

FOR AZIMUTH.

	′
a	·473 S
b	1·50 S
c	1·973 S
dep.	1·500 gives Az. S 33° 41′ E
	Pos.-line S 56 19 W

LATITUDE BY EX-MERIDIAN.

	h. m. s.		
H.A.	4 3 40	Cos	9·68671
Decl.	52° 38′	Cot	9·88289
Arc (1)	20 21·9 S	Tan	9·56960
„ (2)	20 11·6 S		
Lat.	40 33·5 S and posn.-line S 56·3° W		

Az.	33° 41′	Cos	9·92018
Alt.	17 1	Cot	0·51421
Arc (2)	20 11·6	Cot	0·43439

2ND OBSERVATION.

	d. h. m. s.
M.T.G.	19 37 49
Long. 173° 0½′ E	11 32 2
M.T. at Sp.	7 9 51
M. ⊙'s R.A.	15 17 56·5
Sid. T. at Sp.	22 27 47·5
∗'s R.A.	14 32 43·0
∗'s H.A.	7 55 4·5
Supt.	4 4 55·5

FOR AZIMUTH.

	h. m. s.		
Dl.	4 4 56	Sin	9·9428
Alt.	60° 25′	Cos	9·6934
	22° 43′	Sec	0·0351
Az. S 27° 59′ W		Sin	9·6713
or posn.-line N 62° W			

∗ α^2 CENTAURI TO S. WD.

	° ′
Obsd. alt. of ∗	22 51·2
36 ft. Cor.	− 8·2
T. alt.	22 43·0

LATITUDE BY EX-MERIDIAN.

	h. m. s.		
H.A.	4 4 56	Cos	9·68236
Dl.	60° 25′	Cot	9·75411
Arc (1)	15 16·8 S	Tan	9·43647
„ (2)	25 21·9 S		
Lat.	40 38·7 S and posn.-line N 62° W		

Az.	27° 59′	Cos	9·94600
Alt.	22 43	Cot	0·37815
Arc (2)	25 21·9	Cot	0·32415

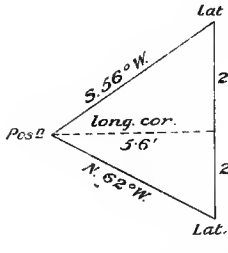


Table M (page 150).

1st obsn. Az. S. 34° E. and Lat. 40° 33′·5 S. gives ·51 lat. error S. to Wd.
2nd obsn. Az. S. 28 W. and Lat. 40 38·7 S. gives ·41 lat. error N. to Wd.

D. lat. 5·2 ÷ ·92 = long. cor. 5·6′ W. × 51′ = lat. cor. 2·86′ S.

Lat. (1)	= 40° 33′·5 S	Long. (1)	173° 0′·5 E
Cor.	2·9 S	Cor.	5·6 W
Lat. in	40 36·4 S	Long. in	172 54·9 E

NOTE.—These observations worked as two chronometer problems gave exactly the same results, but had the second ex-meridian latitude been worked with the azimuth as found by the A and B Tables the latitude would have been nearly 1′ in error, due to a slight change in the star's declination in twelve years; the B Table having been calculated for ∗'s declination in 1910. It is well to remember, however, that the best results will always be obtained by using the sine method with hour-angle and altitude in the calculation of the azimuth, and this is especially the case where the altitude is high.

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